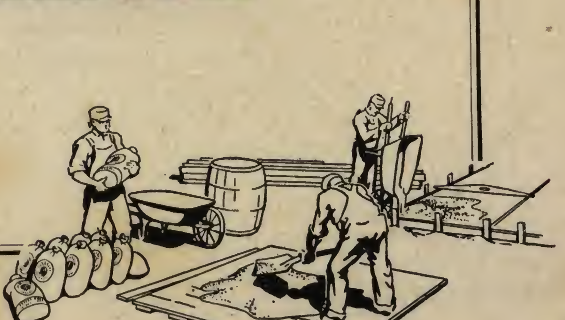
# Manual of PERMANENT FARM CONSTRUCTION

# *Manual of* PERMANENT FARM CONSTRUCTION

ASH GROVE PORTLAND CEMENT

Form A-444



# Table of Contents

# Manual of Permanent Farm Construction

*(Prepared from data compiled by Portland Cement Association)*

## I. Plans for Concrete Farm Buildings

THE United States census report for 1920 shows that more than $11,000,000,000 are invested in farm buildings in this country. This was more than three times the value of all farm machinery at that time and was equal to 14.7 per cent of the value of all farm property. The same report discloses that the value of farm buildings had practically doubled in the ten year period from 1910 to 1920. This increase is significant because it emphasizes the recognized value of well planned substantial farm buildings.

A very definite relation exists between good building equipment and farm profits. Many present structures are inadequate and are responsible for preventable losses amounting to millions of dollars annually. The United States Department of Agriculture estimates that rats eat or destroy over $200,000,000 worth of farm products every year. Such losses can be easily eliminated by observing simple precautions of rat-proofing the various farm buildings, particularly those in which grain is stored. The lack of proper storage facilities for apples and potatoes on many farms is responsible for enormous losses, also preventable. Proper shelter of farm machinery and equipment greatly prolongs their usefulness and increases their efficiency. Farm animals produce more salable products when housed in comfortable quarters. In numerous other ways properly constructed farm buildings are an investment that help the farmer to conduct his business more efficiently and economically.

**Well-built, well-planned farm structures are essential in profitable farm operation.**

# It Pays to Use Concrete

MAXIMUM economy is realized when farm buildings are constructed of concrete; then the *first cost* is practically the *only cost* because of their permanence and freedom from maintenance expense. Usually this makes them the cheapest in the end. Often first cost will be lowest because the owner can do much of the work with his own help during spare time. Sand and pebbles used in the concrete mixture can often be obtained locally for the mere cost of hauling.

The storm-proof and fire-resistive qualities of concrete make it especially suitable for farm buildings. So great is the strength of buildings constructed of this material that even the most severe tornadoes seldom damage them. Concrete has no superior as a fireproofing material. Since farm buildings usually have little or no fire protection in the way of water hydrants and fire-fighting apparatus, it is very important that they be constructed of materials that will not burn.

The resale value of a farm is undoubtedly enhanced when it is equipped with modern concrete buildings. The prospective buyer can afford to pay more for such a farm because upkeep expenses on the buildings will be negligible.

Concrete has many other advantages for farm building construction. For dairy barn floors, milkhouses and other structures where cleanliness is absolutely essential, concrete has no equal and is now used almost to the exclusion of all other materials. Floors and walls of concrete afford the greatest measure of sanitation since they are non-absorbent and do not provide lodgment for filth and disease. Concrete has a decided advantage for the construction of buildings to store feeds and grains because of its ability to exclude rats and vermin.

Concrete farm buildings are storm and fire resistive, attractive in appearance and last indefinitely.

# How to Make Concrete

THE elementary principles of making concrete are quickly and easily understood. Even a beginner can do creditable work if he is careful to observe a number of precautions, and, in a surprisingly short time, he can acquire the necessary experience to successfully undertake more difficult construction.

Tools commonly used in making concrete.

Concrete is a mixture of portland cement, aggregate, and water. By aggregate is meant the sand and pebbles or crushed stone. The proportion of cement to aggregate varies with different kinds of work. For example, tanks, troughs, and other structures that must be watertight are made of a richer mixture than foundation footings which serve only to sustain loads. Suggested mixtures for different kinds of work are given in the table below.

Proportions for concrete mixtures are usually expressed as 1:2:3, 1:2:4, etc. The first figure denotes the number of parts of cement, the second figure the number of parts of sand, and the third, the pebbles or crushed rock. For example, a 1:2:3 mix contains one part cement for each two parts of sand and three parts of pebbles or broken stone. It is important that the materials be measured accurately. A pail, box, wheelbarrow or any other convenient measure may be used. One sack of cement is regarded as one cubic foot. In mixing one sack batches, it is convenient to measure sand and pebbles with a box made to hold exactly two cubic feet, three cubic feet, or any other desired capacity according to the proportions to be used.

## Mix Thoroughly

Concrete may be mixed by hand or by machine. Machine mixing is preferable as it is easier to obtain uniform results. Whichever method is used, the mixing should be continued until every pebble is thoroughly coated with the cement and sand mortar. Use as little water as possible to produce concrete of a plastic (workable) consistency. Avoid sloppy mixtures; too much water reduces the strength of concrete.

**TABLE OF RECOMMENDED MIXTURES AND MAXIMUM AGGREGATE SIZES**

| | | *Largest Size Pebbles or Crushed Rock* |
|---|---|---|
| 1 : 2 : 3 | MIXTURE FOR: | |
| | Concrete walks, porch floors, steps | 1 ½ in. |
| | Feeding floors, basement floors, floors in farm buildings, mangers | 1 ½ in. |
| | Basement walls exposed to moisture, roofs of underground storage cellars | 1 ½ in. |
| | Troughs, tanks, cisterns, hog wallows, well linings, well covers, milk cooling tanks | 1 in. |
| | Fence posts, clothesline posts, grapevine posts, gate posts, corner posts, mail box posts | ¾ in. |
| 1 : 2 : 4 | MIXTURE FOR: | |
| | Engine bases, bases for machinery | 2 in. |
| | Scale pits, dipping vats, hot beds | 1 ½ in. |
| | Reinforced concrete floors and columns | 1 in. |
| 1 : 2½ : 4 | MIXTURE FOR: | |
| | Silo walls, grain bin walls | 1 ½ in. |
| | Walls of barns, hog houses, poultry houses and other farm buildings | 1 ½ in. |
| | Foundation walls and footings | 2 in. |

## Placing Concrete

Concrete should be placed in the forms immediately after being mixed. In foundation and wall construction the concrete should be deposited in layers not more than six inches deep and should be thoroughly tamped and spaded. These operations compact the concrete, release air pockets in the mixture and work large particles away from the face of the forms so that the concrete surface will be smooth and uniform when the forms are removed.

Floors are laid either as one-course or as two-course construction. One-course construction means that the full thickness of the floor is placed at one time, using one standard concrete mixture throughout. In two-course construction the floor is laid in two courses, using a certain mixture for the base and another (usually mortar) for the top or wearing surface. One-course construction is generally more satisfactory.

## Finishing

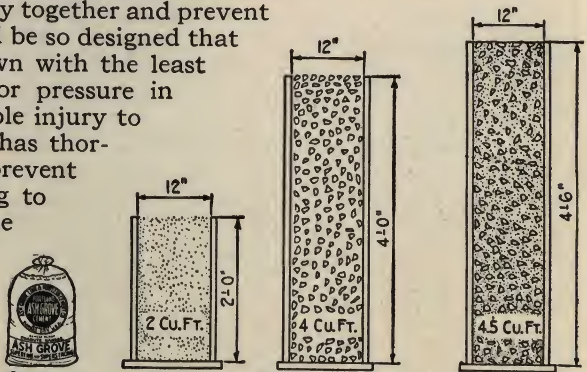
Walks and floors should be finished with a wood float. It will then be smooth, even and yet sufficiently gritty to provide safe footing. A steel trowel should be used only when it is necessary to produce a very smooth surface as in a feed manger or water trough. Use the trowel very sparingly as excess troweling tends to draw the cement to the top, possibly resulting in slippery surfaces or the formation of hair checks.

## Curing

Concrete requires moisture to harden properly. Therefore, it should be protected from the sun and wind in order to prevent the moisture in the concrete from evaporating. Floors and walks can be protected by covering with hay, straw, sand, earth, or other materials as soon as possible without marring the surface. These coverings should be left in place and kept moist for a week or ten days.

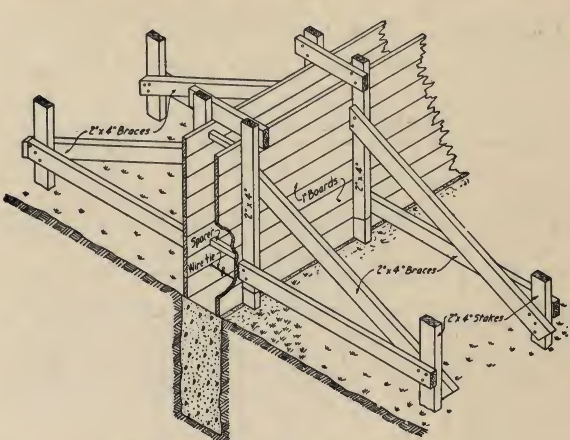
## Forms

Forms are generally made of lumber and where smooth surfaces are desired, dressed and matched lumber should be used. Even for plain work, lumber that has been dressed is best because the boards will fit closely together and prevent leakage. Forms should be so designed that they can be taken down with the least amount of vibration or pressure in order to prevent possible injury to the concrete before it has thoroughly hardened. To prevent concrete from adhering to forms on removal, the faces against which concrete is placed should be given a thin coat of crude oil, machine oil or soft soap. Forms should be rigid, with sufficient bracing




One cu. ft. of cement, 2 cu. ft. of sand, and 4 cu. ft. cf pebbles do not make 7 cu. ft. of concrete, but 4½ cu. ft.

to withstand the pressure of new concrete without bulging. Do not remove forms until the concrete has hardened. In warm weather forms can usually be taken down in two days. In cold weather it may be necessary to wait a week or more.



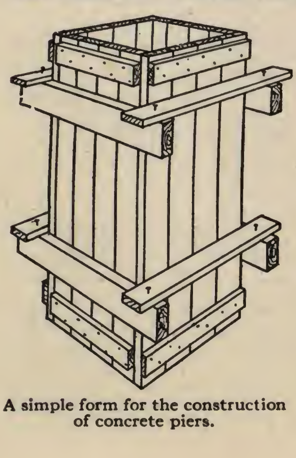
Forms for foundation wall above grade.

## Select Good Materials

Sand and pebbles or crushed rock for concrete mixtures should be clean. Grass, dirt, sticks, and other foreign matter are objectionable because they prevent proper bond between the cement and particles of aggregate. Both sand and pebbles should be well graded, that is, the particles should not be all small or all coarse, but should range from fine up to the maximum size allowable. By sand is meant material fine enough to pass through a screen having four meshes to the inch. Aggregate coarser than this is known as pebbles or broken stone. The maximum size of pebbles allowable varies with the character of the work. (See table on page 5.)

## Reinforced Concrete

Reinforcement is the term used to describe the steel rods or mesh sometimes placed in the concrete to increase its tensile strength. Concrete is a material that, like stone, is strong in compression, that is, very strong in bearing loads that are placed directly upon it, but its strength is not nearly so great in tension, so steel rods or wires are often placed in the concrete to increase its power to resist strains that tend to bend or pull it apart. It is very important that steel reinforcement be placed in the correct position, that is, in that part of the concrete mass where it will be most effective in resisting the tensile stresses. In a concrete lintel or beam the reinforcement is placed near the lower side as that is the side which tends to pull apart when the beam is loaded. In grain bins, water supply tanks, silos and similar structures where the contents exert an outward pressure, the reinforcement is placed near the center of the wall. The construction of reinforced concrete floors above ground, beams, columns and the more elaborate structures, should be undertaken only by an experienced builder. They should be designed by an engineer.


A simple form for the construction of concrete piers.

## Quantities of Cement, Fine Aggregate and Coarse Aggregate Required for One Cubic Yard of Compact Mortar or Concrete

(Based on tables in "Concrete, Plain and Reinforced," by Taylor and Thompson.)

| MIXTURES | | | QUANTITIES OF MATERIALS | | | | |
|---|---|---|---|---|---|---|---|
| Cement | Fine Aggregate (Sand) | Coarse Aggregate (Pebbles or Stone) | Cement in Sacks | Fine Aggregate | | Coarse Aggregate | |
| | | | | Cu. Ft. | Cu. Yd. | Cu. Ft. | Cu. Yd. |
| 1 | 1.5 | .. | 15.5 | 23.2 | 0.86 | .... | .... |
| 1 | 2.0 | .. | 12.8 | 25.6 | 0.95 | .... | .... |
| 1 | 2.5 | .. | 11.0 | 27.5 | 1.02 | .... | .... |
| 1 | 3.0 | .. | 9.6 | 28.8 | 1.07 | .... | .... |
| 1 | 1.5 | 3 | 7.6 | 11.4 | 0.42 | 22.8 | 0.85 |
| 1 | 2.0 | 3 | 7.0 | 14.0 | 0.52 | 21.0 | 0.78 |
| 1 | 2.0 | 4 | 6.0 | 12.0 | 0.44 | 24.0 | 0.89 |
| 1 | 2.5 | 4 | 5.6 | 14.0 | 0.52 | 22.4 | 0.83 |
| 1 | 2.5 | 5 | 5.0 | 12.5 | 0.46 | 25.0 | 0.92 |
| 1 | 3.0 | 5 | 4.6 | 13.8 | 0.51 | 23.0 | 0.85 |

1 sack cement = 1 cu. ft.; 4 sacks = 1 bbl.

## Materials Required for 100 Sq. Ft. of Surface for Varying Thicknesses of Concrete or Mortar

C. = Cement in Sacks.
F.A. = Fine Aggregate (Sand) in Cu. Ft.
C.A. = Coarse Aggregate (Pebbles or Broken Stone) in Cu. Ft.
Quantities may vary 10 per cent either way depending upon character of aggregate used.
No allowance made in table for waste.

| Proportion | 1 : 1½ | | | 1 : 2 | | | 1 : 2½ | | | 1 : 3 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thickness In Inches | C. | F.A. | C.A. | C. | F.A. | C.A. | C. | F.A. | C.A. | C. | F.A. | C.A. |
| ⅜ | 1.8 | 2.7 | | 1.5 | 3.0 | | 1.3 | 3.2 | | 1.1 | 3.4 | |
| ½ | 2.4 | 3.6 | | 2.0 | 4.0 | | 1.7 | 4.3 | | 1.5 | 4.4 | |
| ¾ | 3.6 | 5.4 | | 3.0 | 6.0 | | 2.5 | 6.3 | | 2.2 | 6.8 | |
| 1 | 4.8 | 7.2 | | 4.0 | 7.9 | | 3.4 | 8.4 | | 3.0 | 8.9 | |
| 1¼ | 6.0 | 9.0 | | 4.9 | 9.9 | | 4.2 | 10.5 | | 3.7 | 11.1 | |
| 1½ | 7.2 | 10.8 | | 5.9 | 11.9 | | 5.1 | 12.7 | | 4.4 | 13.3 | |
| 1¾ | 8.4 | 12.6 | | 6.9 | 13.9 | | 5.9 | 14.7 | | 5.2 | 15.7 | |
| 2 | 9.6 | 14.4 | | 7.9 | 15.8 | | 6.8 | 16.9 | | 5.9 | 17.7 | |
| | 1 : 2 : 3 | | | 1 : 2 : 4 | | | 1 : 2½ : 4 | | | 1 : 2½ : 5 | | |
| 3 | 6.5 | 13.0 | 19.3 | 5.6 | 11.2 | 22.4 | 5.2 | 12.9 | 20.6 | 4.6 | 11.5 | 23.0 |
| 4 | 8.6 | 17.2 | 25.8 | 7.5 | 14.9 | 29.8 | 6.9 | 17.1 | 27.5 | 6.2 | 15.4 | 30.7 |
| 5 | 10.8 | 21.6 | 32.2 | 9.4 | 18.7 | 37.4 | 8.6 | 21.5 | 34.3 | 7.7 | 19.2 | 38.3 |
| 6 | 12.9 | 25.8 | 38.6 | 11.2 | 22.4 | 44.7 | 10.3 | 25.8 | 41.2 | 9.2 | 23.0 | 45.9 |
| 8 | 17.2 | 34.4 | 51.6 | 15.0 | 29.8 | 59.7 | 13.7 | 34.3 | 54.9 | 12.3 | 30.7 | 61.3 |
| 10 | 21.5 | 43.2 | 64.4 | 18.7 | 37.4 | 74.8 | 17.2 | 43.0 | 68.6 | 15.3 | 38.3 | 76.6 |
| 12 | 25.8 | 51.6 | 77.2 | 22.4 | 44.7 | 89.4 | 20.6 | 51.6 | 82.4 | 18.4 | 45.9 | 91.8 |

## HOW TO USE TABLES FOR CALCULATING QUANTITIES

**Problem 1:**

What quantities of materials are required for a monolithic concrete foundation wall 34 feet square, outside measurements, 12 inches thick, 7 feet high, with a footing 12 inches thick and 18 inches wide, using a 1:2:4 mixture in both the wall and footing?

**Solution:**

The wall contains 924 square feet of surface, 12 inches thick, deducting for duplication at corners.

Referring to table under 1:2:4 mixture for 12-inch walls, 22.4 sacks of cement are required for each 100 square feet of surface. Dividing 924 by 100 gives the number of times 100 square feet are contained in the total wall surface and multiplying by 22.4 gives the total number of sacks of cement required. Similar calculations are made for the fine aggregate and the coarse aggregate in both the wall and the footing, noting that the width of the footing, 18 inches, is $1\frac{1}{2}$ times the 12 inches thick.

$\frac{924 \times 22.4}{100} = 207$ sacks cement.

$\frac{924 \times 44.7}{100} = 413$ cu. ft. fine aggregate.

$\frac{924 \times 89.4}{100} = 826$ cu. ft. coarse aggregate.

The footing contains 132 square feet of surface, 18 inches thick ($1\frac{1}{2} \times 12$ inches) deducting for duplication at corners.

$\frac{132 \times 22.4 \times 1\frac{1}{2}}{100} = 44.4$ sacks cement.

$\frac{132 \times 44.7 \times 1\frac{1}{2}}{100} = 88.5$ cu. ft. fine aggregate.

$\frac{132 \times 89.4 \times 1\frac{1}{2}}{100} = 177.0$ cu. ft. coarse aggregate.

Total materials required for footing and wall: 251.4 sacks cement, 501.5 cu. ft. fine aggregate, 1003 cu. ft. coarse aggregate.

**Problem 2:**

What quantities of material are required for a 1:2 cement plaster coat, one inch thick on the lower four feet of the above foundation?

**Solution:**

Perimeter of foundation: $4 \times 34$ feet $= 136$ feet. This multiplied by height of plaster coat, 4 ft., equals 544 square feet.

$\frac{544 \times 4.0}{100} = 21.8$ sacks of cement.

$\frac{544 \times 7.9}{100} = 42.5$ cu. ft. sand.

# Concrete Masonry Construction

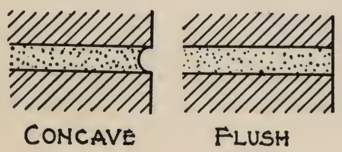
Concrete masonry units lay easily and quickly and take only a small amount of mortar.

PRACTICALLY every community is within hauling or trucking distance of a concrete products plant or material yard where concrete block or concrete building tile are carried in stock. These units are extensively used in farm building construction. Concrete block are made in various sizes. The 8 by 8 by 16-inch block is perhaps the most common. It makes a wall eight inches thick, laid in courses eight inches high. Block are also made regularly for building walls 10 and 12 inches thick. Concrete building tile are usually smaller in size and have thinner walls than block, the standard size being 5 by 8 by 12 inches. They are suitable for constructing walls 8 or 12 inches thick, according to the way the unit is laid in the wall. The height of 5 inches is equivalent to 2 courses of brick.

Most products manufacturers and dealers carry half-length block and tile in stock, making it unnecessary to cut units on the job if a little care is observed in designing the building. It is a simple matter to lay out the building so that its width and length as well as the distance between doors and windows is equal to a given number of full and half length block. For example, a wall exactly 24 feet long will take 18 full block, 16 inches long, in each course; a wall 26 feet long will require 19 full length and one half-length block. Time is saved if the mason is not required to cut block and a more workmanlike job is secured.

## Preparation of Mortar

Portland cement mortar should be used in laying concrete masonry units. A mixture of one part cement, one part well slaked or commercially hydrated lime and six parts clean, screened sand is generally satisfactory. Mix sand, water and cement together thoroughly and keep the batches small enough that they can be used within 30 minutes after the water is added.



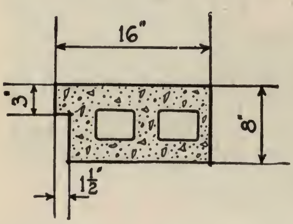

## Mortar Joints

The concave type of mortar joint is usually preferred for farm buildings. It is made by drawing a pointing tool along the joint after the mortar begins to stiffen. This operation compacts the mortar and produces a tight, water-excluding joint. Both vertical and horizontal joints are usually made to average about three-eighths-inch thick. Block and tile are generally made so that their length and height are correspondingly shorter than their designated dimension, to allow for the mortar joints. That is, a block commonly referred to as an 8 by 8 by 16-inch unit actually measures 7⅝ or 7¾ inches high and 15⅝ or 15¾ inches

long. When the wall is to receive a portland cement stucco finish or is to be plastered, the mortar is struck off flush with the wall surface.

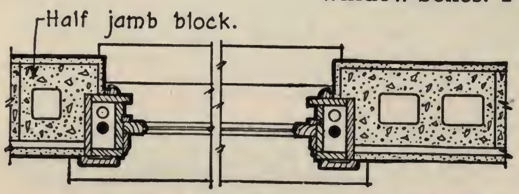
**Corners**

Most manufacturers of concrete block and tile make special units for use in corners. It should never be necessary when making regular 90 degree corners to cut block or fill in with brick bats and in the interest of neat and workmanlike construction, such makeshift means should be avoided. Mortar joints should break at midpoint as nearly as possible.




**Door and Window Specials**

Most products plants furnish special block for use where required against door frames and window boxes. Precast sills and lintels are also carried in stock regularly.



Special door and window jamb block which save time in laying the wall and insure a more workmanlike job.

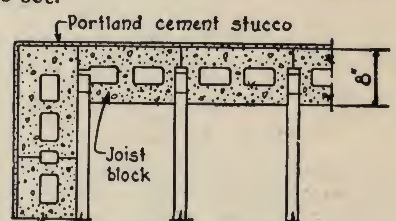
**Setting Joists**

Several methods for setting floor joists in masonry walls are in common use. Some manufacturers produce "joist" block which have notches cut out for the joists as shown in the drawing. Another scheme is to use veneer block on the outside wall, filling in between joists with similar block shortened to the distance between adjacent joists. The basement wall is sometimes made thicker than the wall of the superstructure, then on the ledge or shoulder formed by change in wall thickness the first floor joists are set.

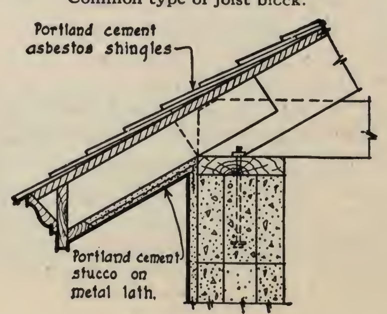
**Attachment of Sills and Plates**

The usual method of attaching wood sills and plates to concrete masonry walls is to bolt them down at intervals, six feet apart or less, to the top course. Bolts should be long enough to extend through the plate and at least one course of masonry. Firmer anchorage is secured by slipping a large washer on the bolt and filling around the latter with concrete.

Our booklet "A Manual of Concrete Masonry Construction" gives complete information on the different types of concrete block and tile and describes the best practices for use in building construction. A copy of this manual will be furnished without charge. Shipment can be made more promptly if your request is addressed to our Kansas City office.



Common type of joist block.



Eave details.

# Farm Building Plan Service

Nothing quite sets off a farm entrance so well as a pair of well-designed concrete posts.

THE plans presented in this booklet are intended to provide ideas and suggestions for designing and constructing needed farm buildings and improvements. Practically all of the plans, selected from thousands of designs, have been accepted as standard by farm building specialists. Most of the plans show the details necessary for constructing the different buildings. If blueprints are desired, however, they can be obtained free on request for all buildings except the residences. For these a charge of $5 per set is made to partly cover architectural fees and cost of making blueprints. Specifications are included with each set of house plans. Plans of the smaller buildings are accompanied by an estimate of materials required to complete the concrete work. Estimates are not given for several of the larger structures since their dimensions will usually be varied to meet individual requirements. However, the data presented on pages 8 and 9 will be found helpful in estimating material requirements in such cases.

## Concrete

"Fertile prairie soil makes thick, sticky mud. It is hard to keep the pigs and steers gaining and the cows clean and comfortable when the mud is knee deep. In fact, there is only one way to do it, and that is to pave the barnyard and floor the buildings with concrete. Many farmers who have done this testify that the original cost is paid back in two or three years, while the concrete, if properly put down, will be as good as ever at the end of 20 years.

"There is no farm improvement that pays better than concrete. Concrete floors keep the rats out of the buildings. Concrete walks keep the mud out of the kitchen. Concrete yards keep the stock out of the mud. They save feed and manure, and the increased comfort of the stock means more rapid gains and a greater milk flow.

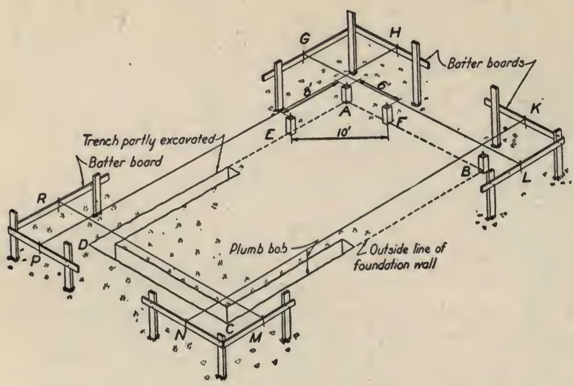
"Oil-stock salesmen talk 25 per cent dividends. Concrete will pay larger dividends than that. The concrete dividends are actually paid. The oil-stock dividends are not."

—*The Prairie Farmer*

# Laying Out the Foundation

THE easiest, quickest, and most accurate way to determine the boundary lines of a new building is by means of surveying instruments. When such instruments are not available, one of the simplest methods for laying out corners, known as the right triangle method, can be used. A triangle with sides 6, 8, and 10 feet long is a right triangle and the 90 degree angle, or right angle, is opposite the longest side.

First, one side or end of the new building is laid out and stakes are driven in at the corners represented by stakes A and B in the figure. To locate the corner points more precisely, nails are partly driven in the tops of each stake. On the line from A to B a stake F is driven which should be exactly 6 feet from stake A. Stake E is then driven so that its center is exactly 8 feet from stake A and 10 feet from stake F. The corner represented by angle E-A-F is a right angle and the line A-E extended forms the second boundary line of the building. Other corners are located in a similar manner. After this is done strings are stretched over the corner stakes A-B-C-D and tied to batter boards at G-H-K, etc., as shown.




This method of laying out foundations assures true walls that are right to receive the remainder of the house.

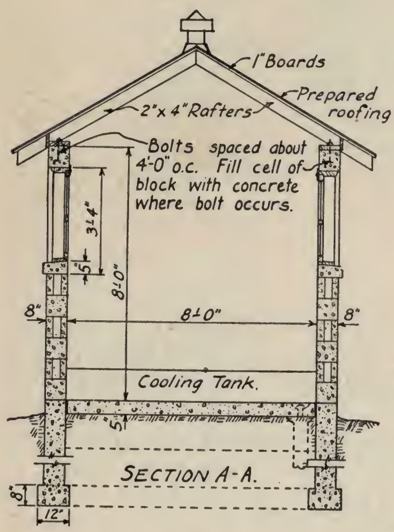
Nails are partly driven in the batter boards at these points so that in case the strings are removed or broken they can be easily replaced. Then the corner stakes A-B-C-D and stakes E and F can be removed so that the trench can be excavated. Having found the building lines, it is easy to locate foundation footings for piers, posts, columns, or other intermediate supports.

Building the foundation.

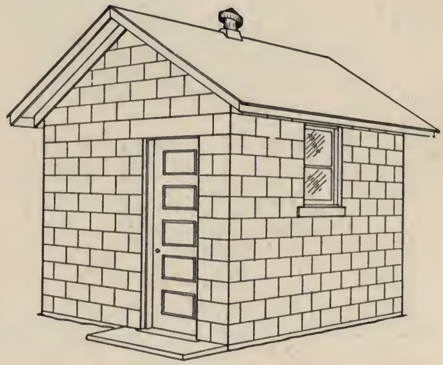
# Milkhouses

A SMALL milkhouse separated from the dairy barn is essential in the production of milk of high quality. Because concrete is so easy to keep in a clean and sanitary condition it is widely used in the construction of milkhouses and cooling tanks.

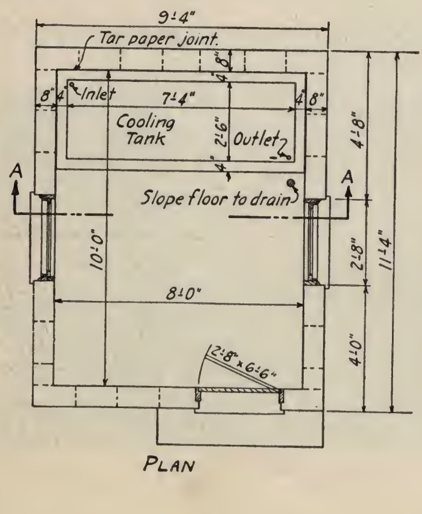
Two types of concrete milkhouses are illustrated—one rectangular and the other circular. A round milkhouse like the one shown can be built by using commercial forms commonly employed in building circular tanks or silos, or it can be built by using the type of concrete block used for block silos.




SECTION A-A.



PERSPECTIVE VIEW.




PLAN

## Rectangular Milkhouse

### CONCRETE MIXTURES

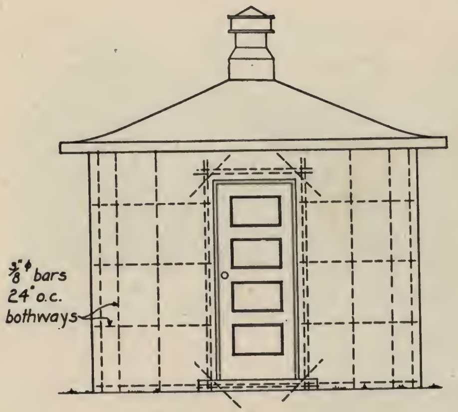
| | |
|---|---|
| Foundation and footing | 1 : 2½ : 4 |
| Floor | 1 : 2 : 4 |
| Cooling Tank | 1 : 2 : 3 |
| Mortar | 1 : 3 |

### MATERIALS REQUIRED

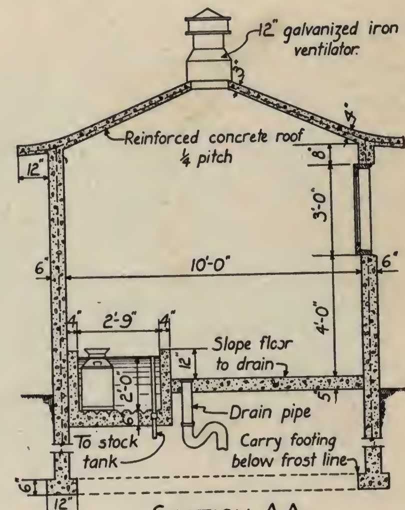
(Estimate based on foundation wall extending 3 feet below grade)

| | |
|---|---|
| Cement | 44 sacks |
| Sand | 4 cubic yards |
| Pebbles or broken stone | 5½ cubic yards |
| Concrete block, 8 by 8 by 16 | 353 |
| Reinforcing steel | 137 feet ⅜-inch rods |

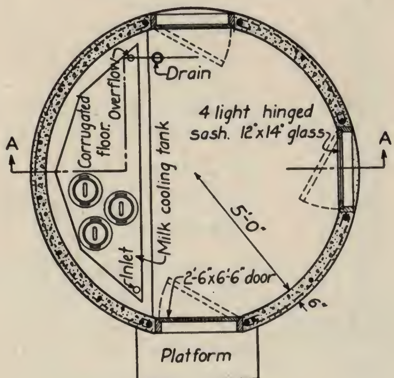
# Circular Milkhouse




FRONT ELEVATION




SECTION A-A




FLOOR PLAN

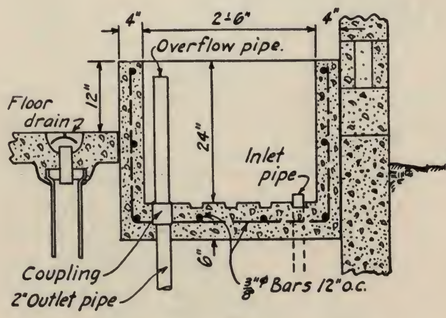
## CONCRETE MIXTURES

| | |
|---|---|
| Walls and foundation | 1 : 2½ : 4 |
| Roof, floor and tank | 1 : 2 : 3 |

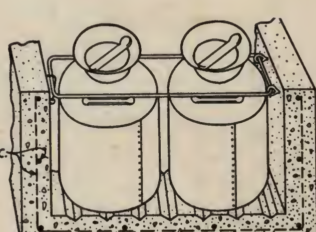
## MATERIALS REQUIRED

(Estimate based on foundation wall extending 3 feet below grade)

| | |
|---|---|
| Cement | 61 sacks |
| Sand | 5½ cubic yards |
| Pebbles or broken stone | 8 cubic yards |
| Reinforcing steel | 805 feet 3/8-inch round rods |




CROSS SECTION THRU TANK.



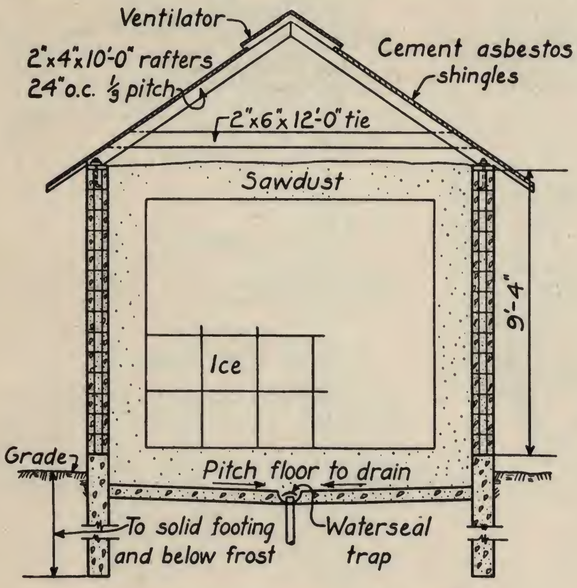

Device for holding cans in tank. Place eyebolts in wall about 21 in. from bottom of tank according to style of can used.

# Icehouse

ICE is used to cool milk on many dairy farms. On every farm a supply of ice will add much to everyone's comfort during the warm days of summer and will simplify the housewife's difficulties in keeping food sweet and wholesome.

Monolithic concrete and concrete block are particularly suitable for ice house construction. Icehouses are always damp and concrete is not susceptible to rot or other forms of depreciation. Concrete is also fireproof. The air spaces in the wall, resulting from the use of concrete block or hollow wall monolithic construction, provide insulation against summer heat so loss from melting is small.

Because for its fireproof and rotproof qualities, concrete is well adapted to icehouse construction.




Cross-section of concrete block icehouse.

## How to Figure Size Needed

In northern states one and one-half tons of ice are required to cool the milk from each cow during the summer. In southern states two tons per cow should be allowed. It is also well to store several tons for use in the home refrigerator. An allowance of 25 per cent is usually figured for shrinkage due to melting. The table of capacities shows sizes needed to store various amounts of ice in tons.

**CAPACITY OF ICEHOUSES**

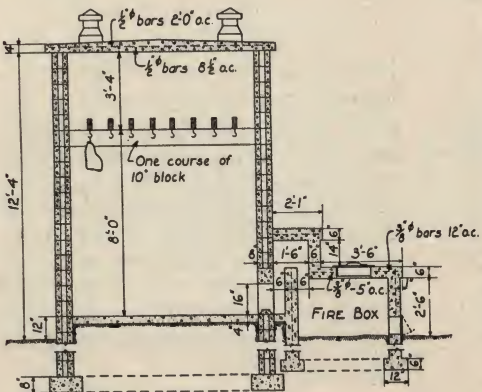
| Height in Feet | Width in Feet | Length in Feet | Capacity in Tons |
|---|---|---|---|
| 10 | 12 | 12 | 18 |
| 10 | 12 | 16 | 25 |
| 10 | 14 | 16 | 30 |
| 12 | 12 | 18 | 35 |
| 12 | 14 | 18 | 43 |
| 12 | 16 | 18 | 50 |
| 12 | 16 | 22 | 62 |
| 12 | 18 | 22 | 71 |
| 14 | 16 | 24 | 82 |
| 14 | 18 | 24 | 94 |
| 14 | 20 | 24 | 105 |

# Smokehouse

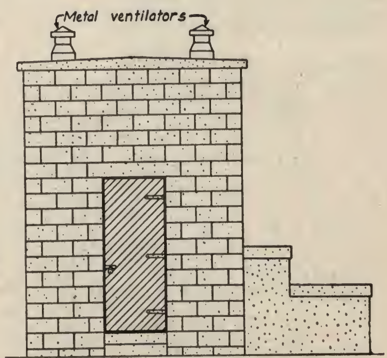
THE old practice of home curing meat by smoking is as popular today as ever. It is easy to build a smokehouse when concrete is the construction material.

Danger of fire in a smokehouse is always very great as the smudge is likely to burst into a blaze. It is, therefore, important that the building be constructed of a fireproof material; then the contents as well as the building will be safeguarded.

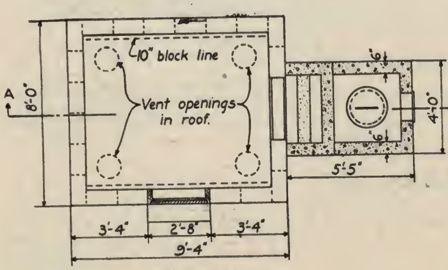
Smokehouse fire dangers are eliminated by concrete construction.




SECTION A-A




SIDE ELEVATION




PLAN

### CONCRETE MIXTURES

| | |
|---|---|
| Foundation walls and footings. | 1: 2½ : 4 |
| Walls above grade, floor, roof and fire pot................ | 1 : 2 : 3 |

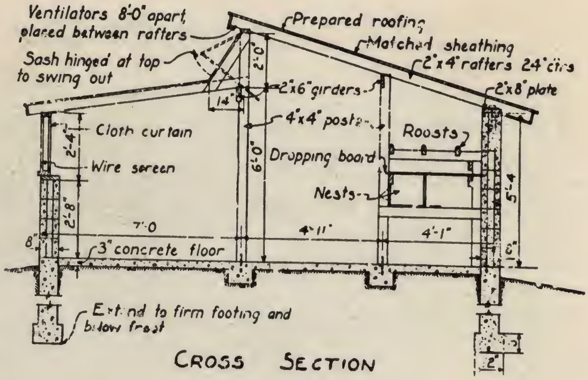
### MATERIALS REQUIRED

(Estimate based on foundation wall extending 3 feet below grade)

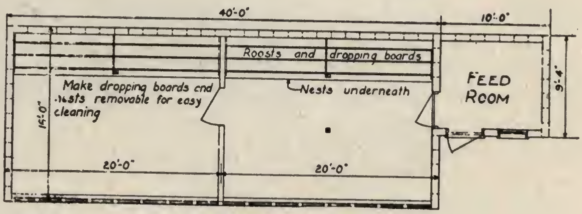
| | |
|---|---|
| Cement..................... | 85 sacks |
| Sand................. | 6¾ cubic yards |
| Pebbles or broken stone. | 12½ cubic yards |

# Poultry Houses

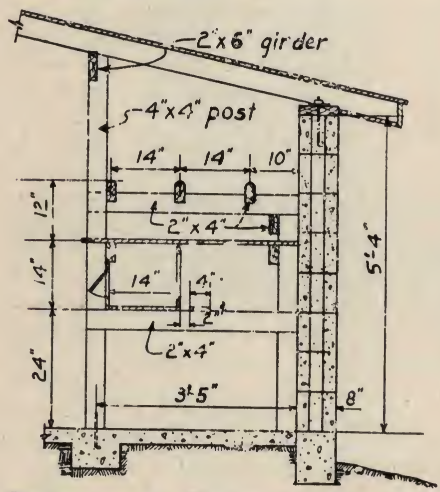
DRY, comfortable, well ventilated quarters which can be easily cleaned and disinfected are essential to a profitable poultry business. These conditions are readily obtained in concrete poultry houses. Such houses afford protection against rats, weasels and other rodents. Lice and mites are easily controlled as there are no crevices in concrete walls and floor in which these parasites can hide.




CROSS SECTION




PLAN




DETAIL OF ROOSTS, NESTS AND DROPPING BOARDS

Two common types of poultry houses are presented. Each is designed so that any capacity desired can be obtained by increasing the length, the width being standard. In determining capacity of poultry house three to four square feet of floor space is allowed per hen, according to breed. Sufficient roosts should be provided so that each grown fowl will have from seven to nine inches of roost space.

## Half Monitor Roof Poultry House

### CONCRETE MIXTURES

| | |
|---|---|
| Walls and foundations | 1 : 2½ : 4 |
| Floor | 1 : 2 : 3 |

### MATERIALS REQUIRED

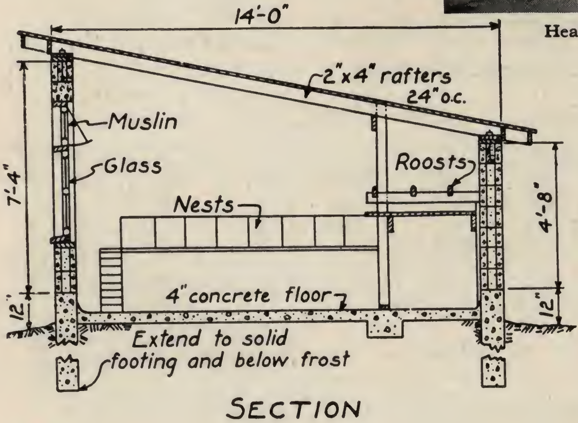
(Size 16 by 50 feet—two sections and feed room. Estimate based on foundation wall extending 3 feet below grade.)

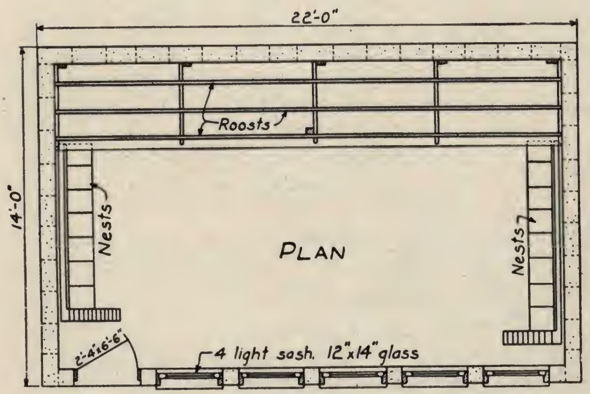
| | |
|---|---|
| Cement | 213 sacks |
| Sand | 19 cubic yards |
| Pebbles or crushed stone | 30 cubic yards |

# Shed Roof Poultry House

Healthful quarters for the hens mean more eggs.

THE shed roof poultry house shown on this page will accommodate 90 grown fowls, allowing 8 inches of roosting space per bird.




Roosts, dropping boards and nests are placed in such location that they are readily accessible yet admit of the most economical use of space.

This type of poultry house, like the half monitor type, gives the best results when faced to the south or to the east, southern exposure being preferred by most poultry men. An abundance of light is provided by large areas of window glass. Frames covered with muslin are set in the wall directly over the windows to permit entrance of fresh air for the fowls. These may be replaced by windows in winter to conserve heat.

## CONCRETE MIXTURES

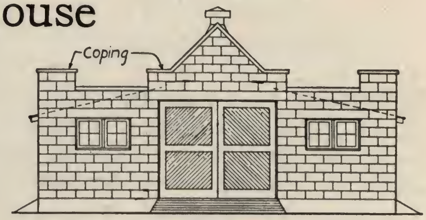
| | |
|---|---|
| Footings and foundation walls | 1 : 2½ : 4 |
| Floor | 1 : 2 : 3 |
| Mortar for laying block | 1 : 3 |

## MATERIALS REQUIRED

(Outside dimensions, 14 by 22 ft. Estimate based on foundation wall extending 3 feet below grade.)

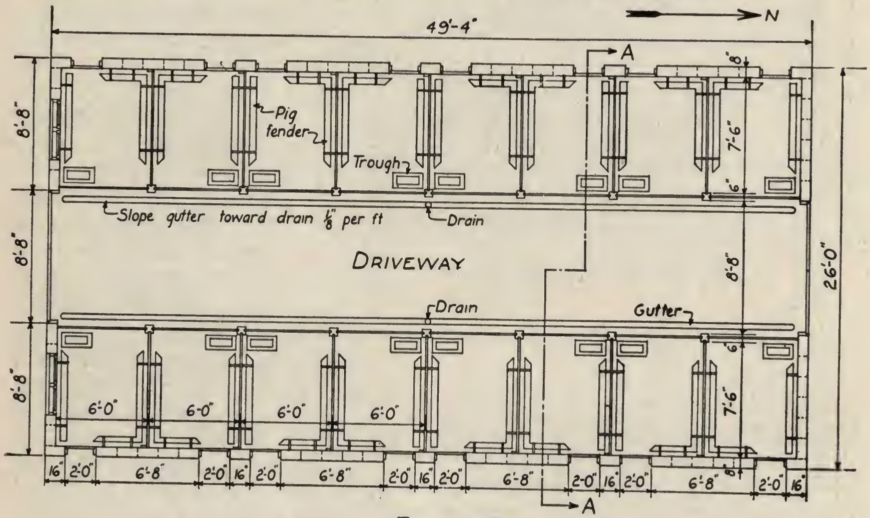
| | |
|---|---|
| Cement | 69 sacks |
| Sand | 5½ cubic yards |
| Pebbles or broken stone | 8½ cubic yards |
| Concrete block (8 by 8 by 16 inch) | 400 |
| Half block | 40 |

# Skylight Hog House

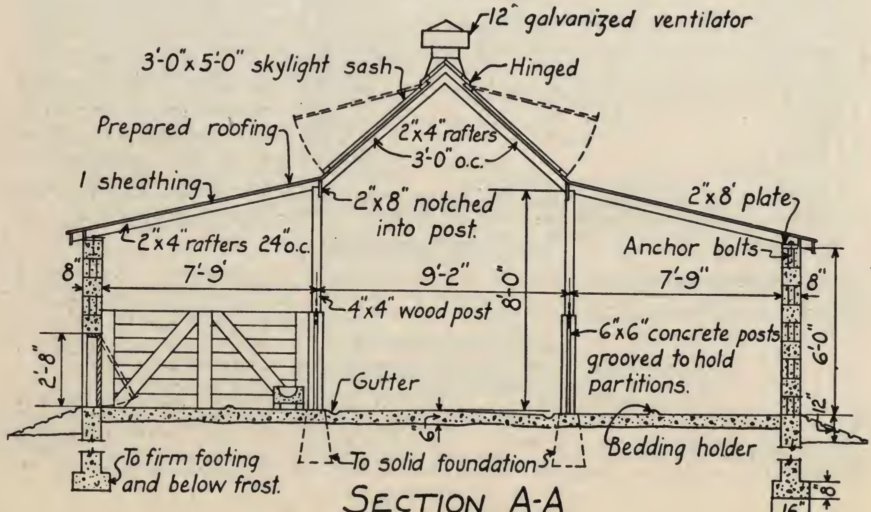



END ELEVATION

THE skylight hog house is so-called because of the rows of skylight sash on the roof which admit sunlight. A hog house of this type is generally built in a north and south direction; then the morning sun entering the row of windows on the east slope of the roof shines in the west row of pens. In the afternoon the sun shining through the windows on the west slope strikes the east row of pens.

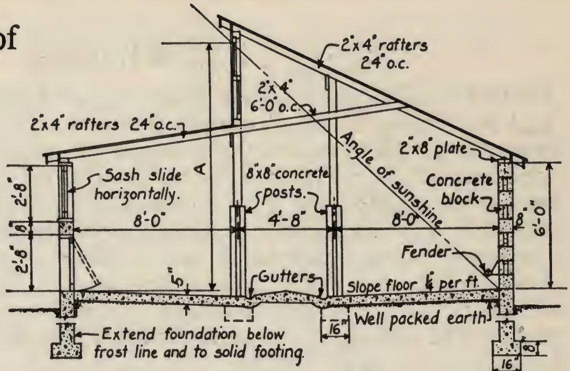



FLOOR PLAN




SECTION A-A

# Half Monitor Roof Hog House



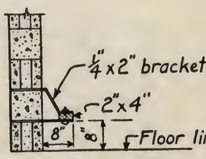

SECTION A-A

THE half monitor roof type of hog house is designed to face the south. The windows in the monitor are placed at such a height that the direct sunlight falls on the floor in the north row of pens during the farrowing season. The table given below will help the builder determine the correct placing of windows in different latitudes and for different farrowing dates. This table assumes a distance of 12 feet from a point directly below the window to the north wall of the building. The south row of pens is usually lighted by windows in the south wall, although these are sometimes located in the roof just over the pens.

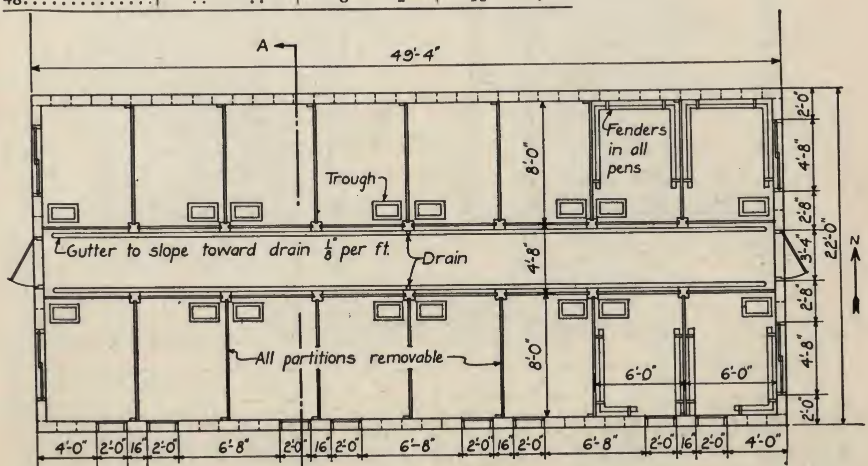
**CONCRETE MIXTURES**

| | |
|---|---|
| Foundations and footings | 1 : 2½ : 4 |
| Floor, posts | 1 : 2 : 4 |

| Latitude Degrees N. | HEIGHT TO TOP OF WINDOW | | | | | |
|---|---|---|---|---|---|---|
| | Farrowing February 1 Ft. | In. | Farrowing March 1 Ft. | In. | Farrowing April 1 Ft. | In. |
| 30 | 11 | 1 | 15 | 6 | 25 | 0 |
| 32 | 10 | 4 | 14 | 5 | 22 | 11 |
| 34 | 9 | 8 | 13 | 5 | 21 | 1 |
| 36 | 9 | 0 | 12 | 7 | 19 | 6 |
| 38 | 8 | 4 | 11 | 8 | 18 | 1 |
| 40 | 7 | 9 | 10 | 11 | 16 | 9 |
| 42 | .. | .. | 10 | 2 | 15 | 7 |
| 44 | .. | .. | 9 | 6 | 14 | 6 |
| 46 | .. | .. | 8 | 10 | 13 | 6 |
| 48 | .. | .. | 8 | 2 | 12 | 7 |




DETAIL OF FENDER



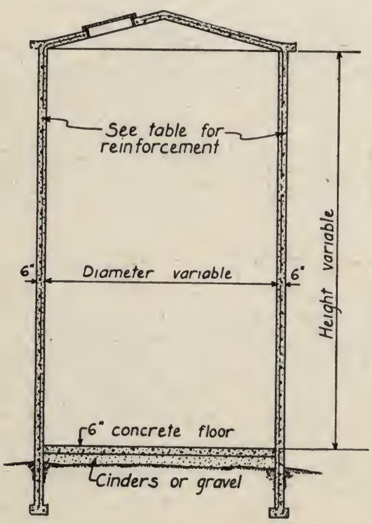

Floor Plan.

# Granaries

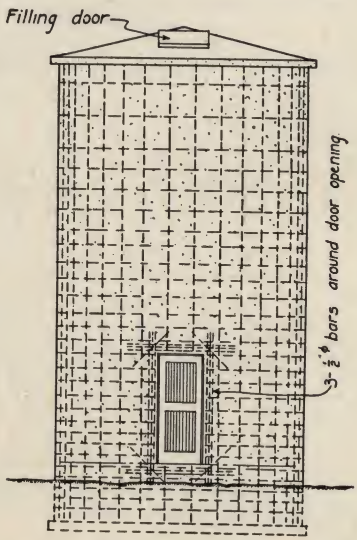
CONCRETE has decided advantages for the construction of storage structures for grains because of its fireproof and vermin-proof properties. The majority of modern elevators are now constructed of concrete. It is equally suitable for the construction of bins for the storage of grain on the farm. One of the prime essentials of a grain bin is that it have moisture-proof walls and floor. For the walls a 1:2½:4 mixture is recommended and for the floor a 1:2:3 mixture. Additional protection against soil moisture is obtained by placing the floor on a well compacted fill of coarse aggregate or cinders from six to eight inches deep. The correct thicknesses of walls and the proper amount of reinforcement for both circular and square bins are shown in the tables.

## Circular Grain Bins

The table below indicates proper amount of reinforcement for circular bins of various depths and diameters. Suppose it is desired to determine correct reinforcement for a bin 12 feet in diameter and 15 feet deep. The table shows that ⅜-inch rods spaced 24 inches apart should be used in the upper 5 feet; ⅜-inch rods 18 inches apart in the middle 5 feet and ⅜-inch rods 15 inches apart in the lower 5 feet. For vertical reinforcement use ⅜-inch rods 18 inches apart in all bins irrespective of size. Walls are 6 inches thick.




SECTION




ELEVATION

**REINFORCEMENT FOR CIRCULAR BINS**

| Depth in Feet From Top | Diameter in Feet | | | | | |
|---|---|---|---|---|---|---|
| | 10′ | 12′ | 14′ | 16′ | 13′ | 20′ |
| 0- 5 | ⅜"@24" | ⅜"@24" | ⅜"@24" | ⅜"@24" | ⅜"@24" | ⅜"@18" |
| 5-10 | ⅜"@24" | ⅜"@18" | ⅜"@15" | ⅜"@12" | ⅜"@12" | ⅜"@12" |
| 10-15 | ⅜"@18" | ⅜"@15" | ⅜"@12" | ⅜"@10" | ⅜"@ 8" | ⅜"@ 6" |
| 15-20 | ⅜"@15" | ⅜"@12" | ⅜"@10" | ⅜"@ 8" | ⅜"@ 6" | ⅜"@ 6" |
| 20-25 | ⅜"@15" | ⅜"@12" | ⅜"@ 8" | ⅜"@ 6" | ⅜"@ 6" | ⅜"@ 5" |

### CONCRETE MATERIALS REQUIRED FOR CIRCULAR BINS OF VARIOUS DIAMETERS

(These figures include footings and floor, but not roof. Walls 6 inches thick. Foundation and footing, and walls 1:2½:4 mixture; floor 1:2:3 mixture)

| Inside Diameter Feet | For Bin 10 Feet Deep | | | For Each Additional 5 Feet in Depth | | |
|---|---|---|---|---|---|---|
| | Cement Sacks | Sand Cu. Yd. | Pebbles Cu. Yd. | Cement Sacks | Sand Cu. Yd. | Pebbles Cu. Yd. |
| 10 | 67 | 6.5 | 10.0 | 16.0 | 1.5 | 2.4 |
| 12 | 83 | 7.7 | 12.3 | 19.2 | 1.8 | 2.9 |
| 14 | 97 | 9.0 | 14.4 | 22.5 | 2.1 | 3.4 |
| 16 | 111 | 10.3 | 16.5 | 25.7 | 2.4 | 3.8 |
| 18 | 125 | 11.6 | 18.6 | 29.0 | 2.7 | 4.3 |
| 20 | 139 | 12.7 | 20.3 | 32.3 | 3.0 | 4.8 |

### CAPACITY OF CIRCULAR BINS IN BUSHELS

| Height in Feet | Diameter in Feet | | | | | |
|---|---|---|---|---|---|---|
| | 10 | 12 | 14 | 16 | 18 | 20 |
| 10 | 631 | 910 | 1238 | 1616 | 2042 | 2525 |
| 15 | 946 | 1364 | 1855 | 2420 | 3060 | 3785 |
| 20 | 1212 | 1820 | 2475 | 3230 | 4090 | 5050 |
| 25 | 1578 | 2275 | 3095 | 4040 | 5100 | 6310 |

## Square Grain Bins

Upper figures give thickness of wall in inches. Lower figures give size and spacing of rods. For example, a grain bin 10 feet square and 10 feet deep should have walls 5½ inches thick and be reinforced with ½-inch rods 8 inches apart in the upper 5 feet and ½-inch rods 6 inches apart in the lower 5 feet. Center of horizontal steel to be 1¼ inches from outside face of wall. Vertical reinforcement to be ½-inch rods placed 18 inches apart.

### REINFORCEMENT AND WALL THICKNESSES OF SQUARE BINS

| Depth in Feet From Top | Dimensions in Feet | | | |
|---|---|---|---|---|
| | 8x8 | 10x10 | 12x12 | 14x14 |
| | 4" | 4" | 4½" | 6" |
| 0- 5 | ½"@10" | ½"@8" | ⅝"@10" | ⅝"@9" |
| | 4" | 5½" | 6½" | 8" |
| 5-10 | ½"@ 8" | ½"@6" | ⅝"@ 8" | ⅝"@6" |
| | 4½" | 5½" | 7" | 9" |
| 10-15 | ½"@ 6" | ½"@6" | ⅝"@ 6" | ⅝"@5" |
| | 4½" | 6" | 7" | 9½" |
| 15-20 | ½"@ 6" | ½"@6" | ⅝"@ 6" | ⅝"@5" |

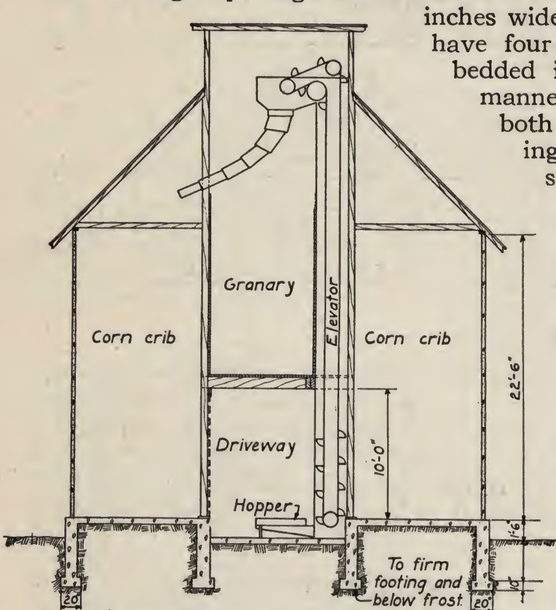
### CAPACITY OF SQUARE BINS IN BUSHELS

| Height in Feet | Dimensions in Feet | | | |
|---|---|---|---|---|
| | 8x8 | 10x10 | 12x12 | 14x14 |
| 5 | 400 | 625 | 900 | 1225 |
| 10 | 800 | 1250 | 1800 | 2450 |
| 15 | 1200 | 1875 | 2700 | 3675 |
| 20 | 1600 | 2500 | 3600 | 4900 |

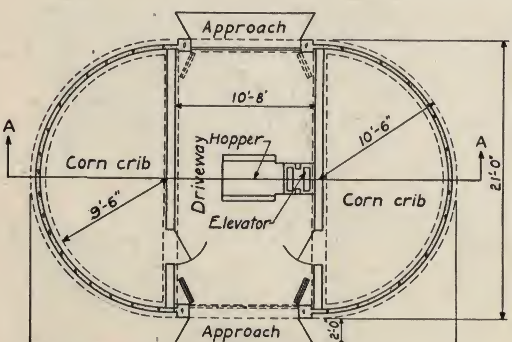
# Farm Elevator

ON many farms the corn crib and granary are combined in one structure known as a farm elevator. The circular form is especially suited to masonry grain storage structures as this shape is easy to reinforce. There is also an economy of materials as a circular structure will enclose a greater volume for a given amount of wall space than any other form. One of the most recent developments in farm buildings is the concrete stave farm elevator. Ventilation is provided in the corn cribs through openings in the staves. These openings are each four inches wide and nine inches long and have four one-quarter-inch rods imbedded in the concrete in such a manner that they pass through both openings, forming a grating for excluding rodents. The staves average around two and one-half inches thick, thirty inches long and ten inches wide. The cribs of this installation are usually semicircular in plan. Storage bins for grain are provided over the driveway. Steel hoops serve as reinforcement. The ends of the hoops are rigidly secured to heavily reinforced concrete door jambs up to the top of the driveway doors. Above this point the rods are carried continuously around the structure. As the lateral pressure of the small grain is greater than that for ear corn, the additional reinforcement for grain bins is provided in the steel channels and "I" beams.

Several types of concrete staves and block suitable for corn crib construction have been developed. Such elevators are usually built by concrete products manufacturers specializing in the business. The names of such companies will be furnished on request.




LONGITUDINAL SECTION A-A

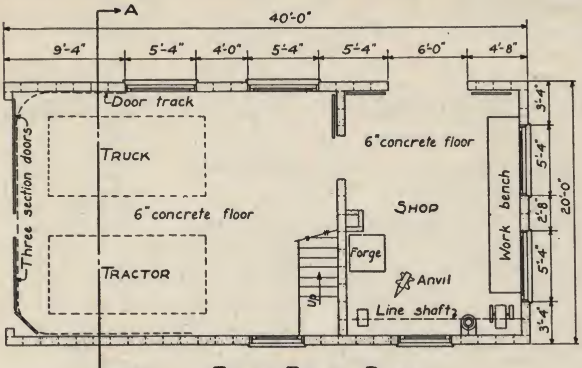



PLAN

# Tractor Shed and Farm Shop

The farm truck and tractor deserve to be housed in a fire and storm safe structure like this.

LIKE the automobile the truck and tractor deserve careful housing. It is convenient to include the farm shop in the same building. Then necessary repair work and overhauling can be done in winter or in bad weather. There is also an economy of construction in thus combining the tractor shed and shop because they have one wall in common.



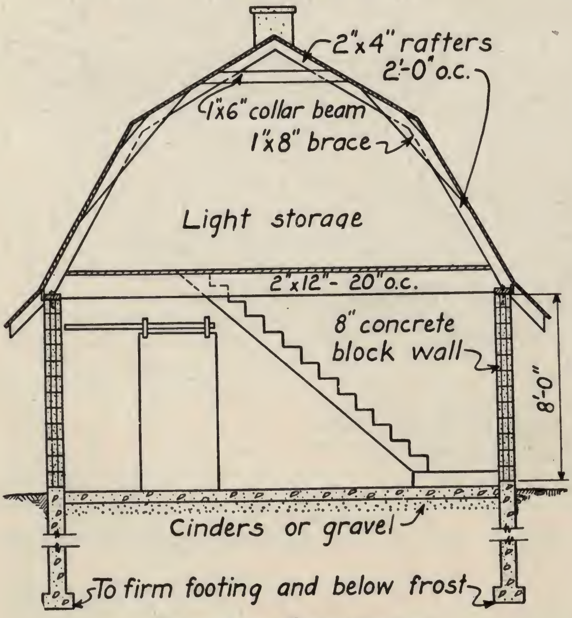


FIRST FLOOR PLAN

The plan shown provides storage space for a farm truck in addition to the tractor with plenty of working room around and between them. There is also space foı the storage of supplies necessary for their operation.

Concrete floors are specified for both rooms. Such a floor is durable, easily cleaned and permits heavy machinery to be moved on it readily. The floor is made 6 inches thick of 1:2:4 concrete.

The building has been designed for concrete block construction using units 16 inches long, 8 inches high, and 8 inches thick. Monolithic construction, with single or double wall can be used.





CROSS SECTION

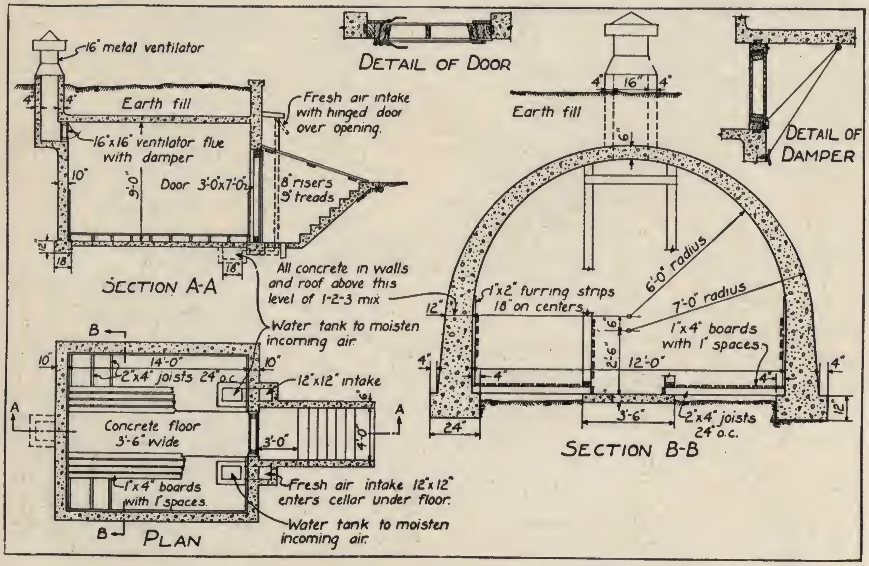
CONCRETE MIXTURES

| | |
|---|---|
| Footings and foundation | 1 : 2½ : 4 |
| Floor | 1 : 2 : 4 |

# Storage Cellar

Fruits and vegetables can be kept in good condition in a concrete storage cellar.

WITH a well designed storage cellar the grower can store his fruit and vegetables until market conditions are favorable. He is not compelled to sell his crop at harvest time when low prices usually prevail. Storage cellars are generally partly covered with earth to get the benefit of the insulation




## Arched Roof Storage Cellar

### CONCRETE MIXTURES

| | |
|---|---|
| Footings | 1 : 2½ : 4 |
| Wall | 1 : 2 : 4 |
| Arched roof | 1 : 2 : 3 |

### MATERIALS REQUIRED

(Inside dimensions 12 by 14 feet.)

| | |
|---|---|
| Cement | 172 sacks |
| Sand | 14 cubic yards |
| Pebbles | 21¾ cubic yards |

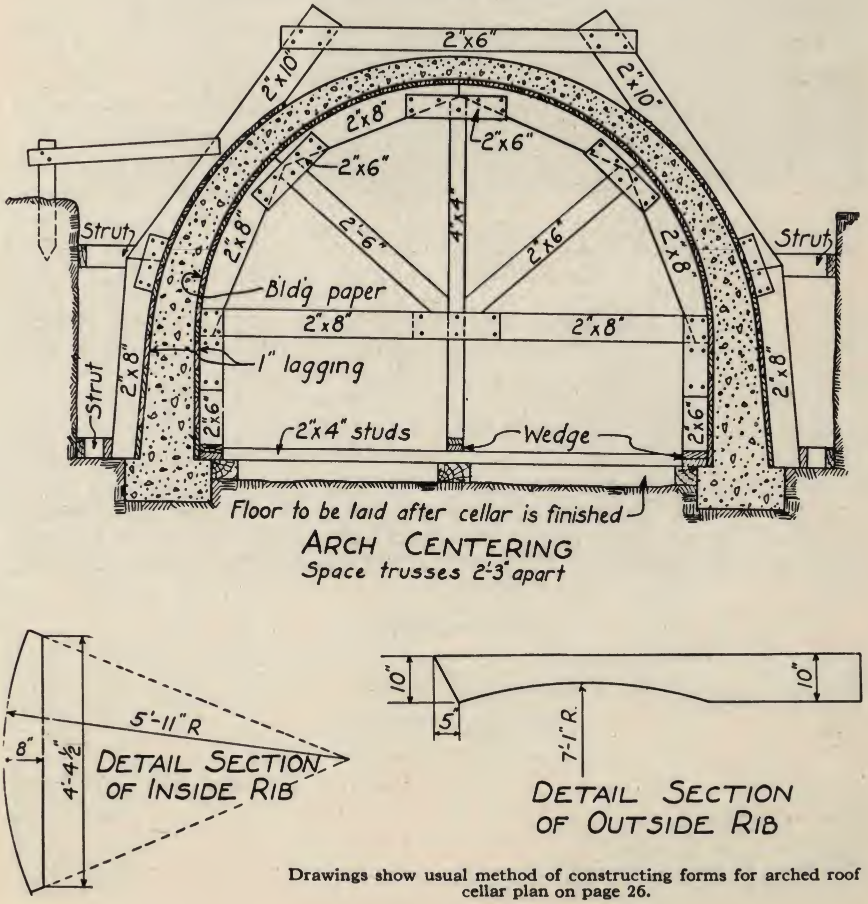
For each additional foot in length, the following material will be required:

| | |
|---|---|
| Cement | 6½ sacks |
| Sand | ½ cubic yard |
| Pebbles or broken stone | 1 cubic yard |

it affords both in summer and in winter. Only masonry materials should be considered for storage cellar construction since the damp earth covering would cause the rapid decay of less permanent materials. Concrete is most widely used because it is watertight, possesses great strength and is permanent.

Concrete is the ideal material for storage cellar construction.

## Forms for Arched Roof Cellar




Drawings show usual method of constructing forms for arched roof cellar plan on page 26.

# Storage Cellar of Large Capacity

THE storage cellar shown has a capacity of approximately 5,000 bushels. This capacity can be increased by using the driveway for storage in emergencies. The cellar is designed in ten-foot units and can be lengthened or shortened to give any capacity desired.

## Temperature of Storage

Apples, potatoes, beets, carrots, and other fruit, roots, and vegetables will keep best at a temperature between 32 and 40 degrees F. The normal temperature of the earth is around 50 degrees F. In order to reduce and maintain the proper temperature in a storage cellar, cold air must be brought in from the outside. During the early fall months, there are nights when the temperature drops near or below the freezing point. Advantage must be taken of these nights to cool the storage cellar. To accomplish this it is essential that the cellar be equipped with proper intakes and outtakes to secure a rapid change and circulation of air.

Concrete combines rotproofness, water tightness, and great strength and is therefore universally used for storage cellar construction.

In the accompanying design, the fresh or cold air intakes are located on each side of the entrance doors. The cold air is delivered into the cellar close to the floor. The warm air that rises to the ceiling is drawn off through the two roof ventilators. In this way circulation of air is complete and in the course of one night the air is changed many times. On warm days and nights all ventilators and intakes are closed to keep the cold air in the cellar. They are not opened again until the next cold spell.

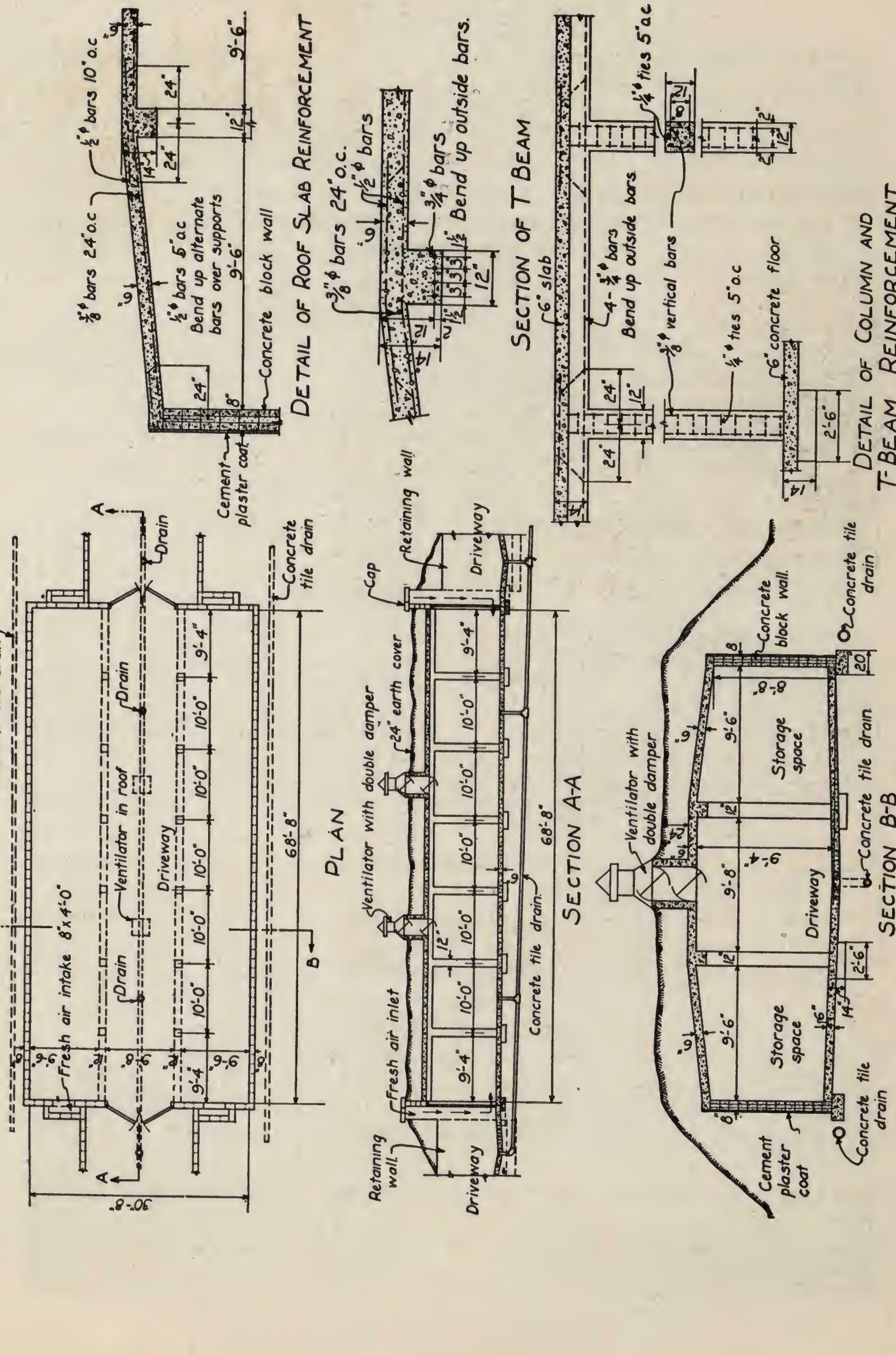
### CONCRETE MIXTURES

| | |
|---|---|
| Footing | 1 : 2½ : 4 |
| Floor and roof | 1 : 2 : 4 |
| Walls (concrete block or hollow wall monolithic construction) | 1 : 2 : 4 |

### MATERIALS REQUIRED

(Inside dimensions 30 feet 6 inches by 69 feet.)

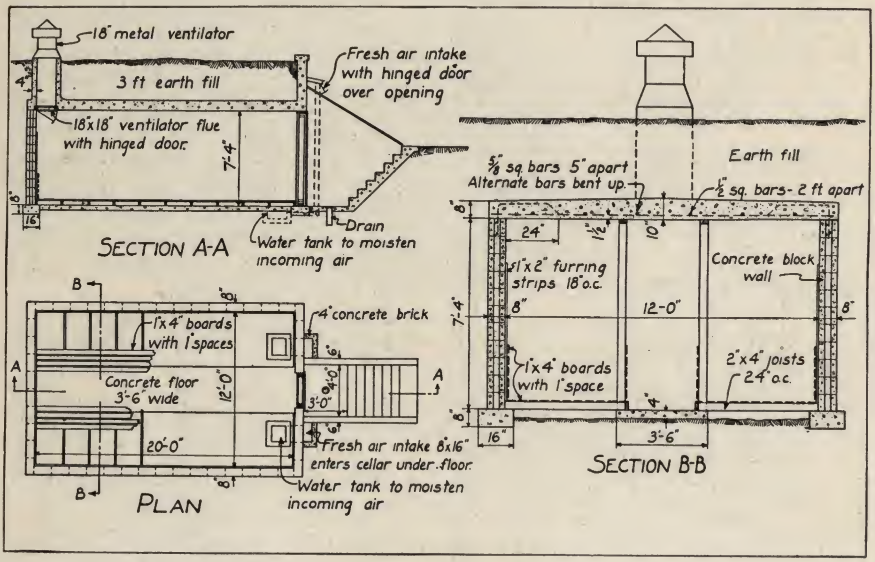
| | |
|---|---|
| Cement | 635 sacks |
| Sand | 51 cubic yards |
| Pebbles or brcken stone | 92 cubic yards |
| Concrete block (8 by 8 by 16 inch) | 2,058 |
| Reinforcement rods (⅜ inch) | 480 lineal feet |
| Reinforcement rods (¼ inch) | 864 lineal feet |
| Reinforcement rods (½ inch) | 3,400 lineal feet |
| Reinforcement rods (¾ inch) | 720 lineal feet |




Design for large storage cellar described on page 28.

# Flat Roof Cellar

REINFORCING steel must be used in the roof of the flat roof cellar shown below. Bars ⅝-inch square are spaced 5 inches apart, center to center, and placed 1½ inches from the bottom of the slab. Alternate bars are bent up at a point 2 feet from the inside cellar wall. The ends of all bars are bent at right angles to form a hook about 3 inches long. This insures good anchorage in the concrete. One-half-inch square bars, placed 2 feet apart, are run lengthwise of the roof slab.




**CONCRETE MIXTURES**

| | |
|---|---|
| Footings | 1 : 2½ : 4 |
| Walls and roof | 1 : 2 : 4 |

**MATERIALS REQUIRED**

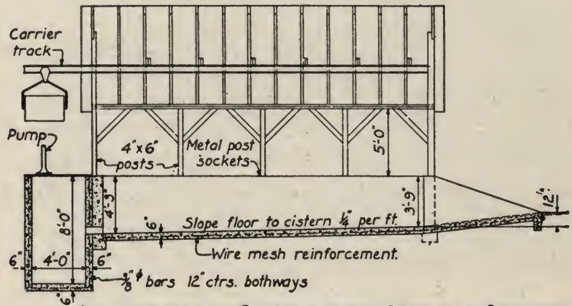
(Inside dimensions 12 by 20 feet)

| | |
|---|---|
| Cement | 191 sacks |
| Sand | 16¾ cubic yards |
| Pebbles or broken stone | 28¼ cubic yards |
| Steel bars (½ inch) | 120 feet |
| Steel bars (⅝ inch) | 720 feet |

For each additional foot of length, the following material will be required:

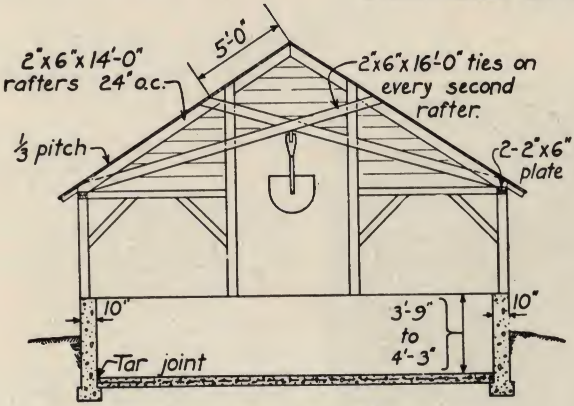
| | |
|---|---|
| Cement | 6 sacks |
| Sand | ½ cubic yard |
| Pebbles or broken stone | (nearly) 1 cubic yard |
| Steel bars (½ inch) | 6 feet |
| Steel bars (⅝ inch) | 36 feet |

# Manure Pit




LONGITUDINAL SECTION THRU CISTERN & DRIVEWAY.

On most farms it is impractical to haul manure to the field daily. A manure pit is then essential to prevent loss of the valuable fertilizing elements. Concrete is the preferred material for manure pit construction because the watertight walls and floors do not permit any of the liquids to escape and the decomposition of the solids can be controlled so there is no loss of plant food.




CROSS SECTION

A location convenient for filling and emptying the pit is essential. In a pit of large size a driveway will save time and labor in loading. For long pits it is a good plan to build an approach at each end so that the spreader can be driven entirely through.

### CONCRETE MIXTURES

| | |
|---|---|
| Walls and footings | 1 : 2½ : 4 |
| Cistern and pit floor | 1 : 2 : 3 |

### MATERIALS REQUIRED

(Inside dimensions 20 by 24 feet)

| | |
|---|---|
| Cement | 165 sacks |
| Sand | 14 cubic yards |
| Pebbles or broken stone | 21½ cubic yards |
| Rods (⅜-inch) | 320 lineal feet |
| Wire mesh reinforcement | 560 square feet |

### DIMENSIONS OF PITS FOR DAIRY HERDS OF DIFFERENT SIZES

| No. of Cows | Length | Width | Average Depth |
|---|---|---|---|
| 10 | 16 feet | 16 feet | 4 feet |
| 20 | 24 feet | 20 feet | 4 feet |
| 30 | 30 feet | 24 feet | 4 feet |
| 40 | 40 feet | 24 feet | 4 feet |

Beauty is combined with permanence in a well-built concrete garage.

Maximum fire protection is afforded by the garage built of concrete.

Concrete masonry units make speedy erection possible.

# Gar

CONCRETE has outstanding a
account of its firesafeness, at
The plans shown are for a one-car
Either block with a special facing
latter provides an excellent backin
For a single-car garage an inside wi
satisfactory and for a two-car ga
length of less than twenty feet
twenty-two feet is better. These
space around the car and provide
and shelves for car accessories at o

## One-Ca

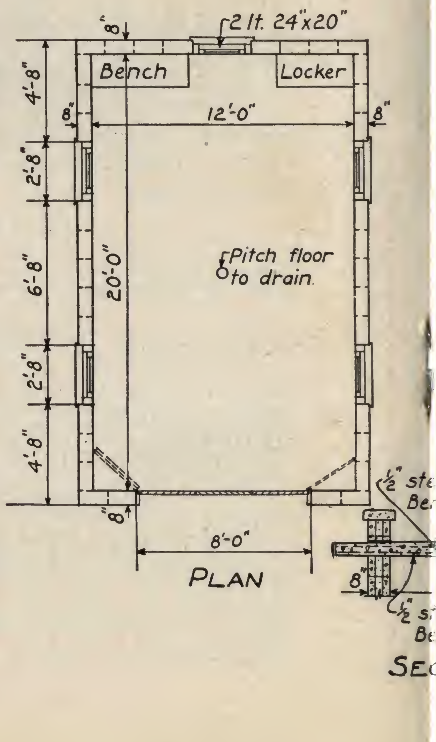
**CONCRET**

| | |
|---|---|
| Foundations and footings.................... | |
| Floor.................................... | |
| Sills and lintels........................... | |
| Mortar.................................... | |

**MATERIAL**

(Inside dimensions 12 by
on foundation wall exte

| | |
|---|---|
| Cement.................................... | |
| Sand...................................... | |
| Pebbles or broken stone..................... | |
| Concrete block (8 by 8 by 16 inch)............ | |
| Half block (8 by 8 by 16 inch)................ | |
| Corner block (8 by 8 by 16 inch).............. | |



## ages

ɩvantages for garage construction on ractiveness and low cost of upkeep. ;arage constructed of concrete block. or plain block may be used. The for a portland cement stucco finish. ːh of twelve feet has been found very ɪge twenty or twenty-two feet. A ɜ seldom advisable—for larger cars ɪimensions allow plenty of working room for a small work bench, closet ɪe end.

## r Garage

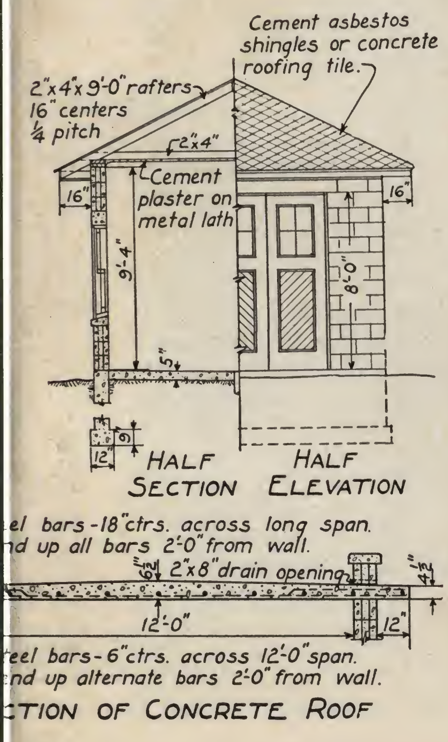
**: MIXTURES**

| | |
|---|---|
| ................................... | 1 : 2½ : 4 |
| ................................... | 1 : 2 : 3 |
| ................................... | 1 : 2 : 3 |
| ................................... | 1 : 3 |

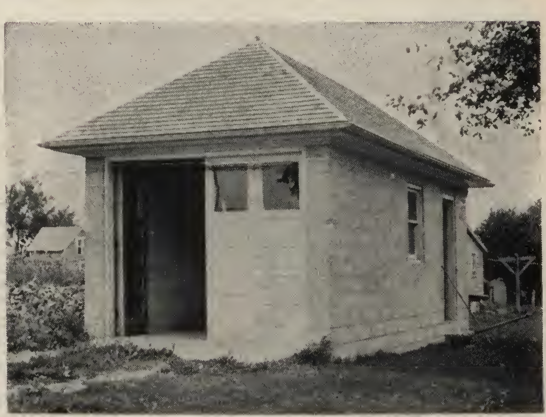
**; REQUIRED**

**20 feet. Estimate based ding 3 feet below grade.)**

| | |
|---|---|
| ................................... | 86 sacks |
| ................................... | 8¼ cubic yards |
| ................................... | 11¼ cubic yards |
| ................................... | 460 |
| ................................... | 42 |
| ................................... | 56 |




Upkeep expenses are low, as concrete will not rot and requires no painting.

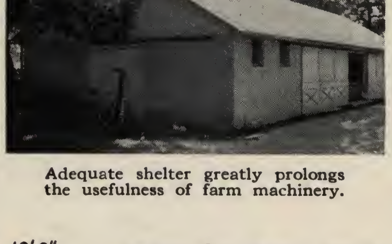


Concrete garages withstand severe wind storms.

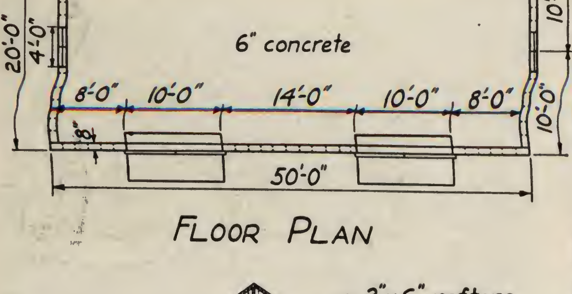
Completing the walls of a firesafe, permanent, two-car garage.

# Implement Shed

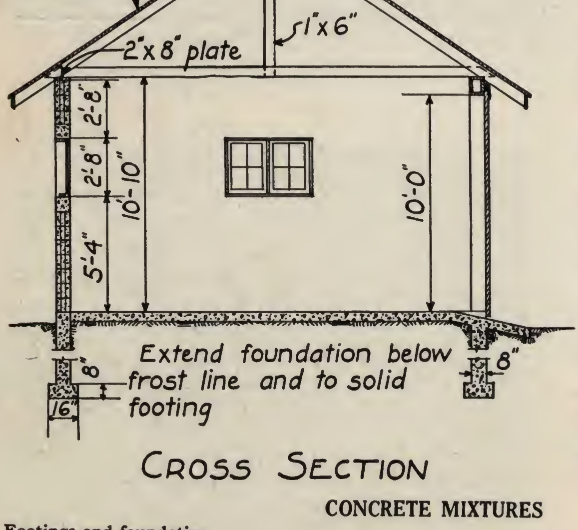
MOST farm machines are actually used only a comparatively short time each year and if they are not protected from the weather are attacked by rust and rot and soon become useless. On the average farm the amount of money spent for farm implements justifies the erection of a building which will afford them adequate protection. Such *a building will pay good returns on the investment.*



Adequate shelter greatly prolongs the usefulness of farm machinery.




FLOOR PLAN




CROSS SECTION

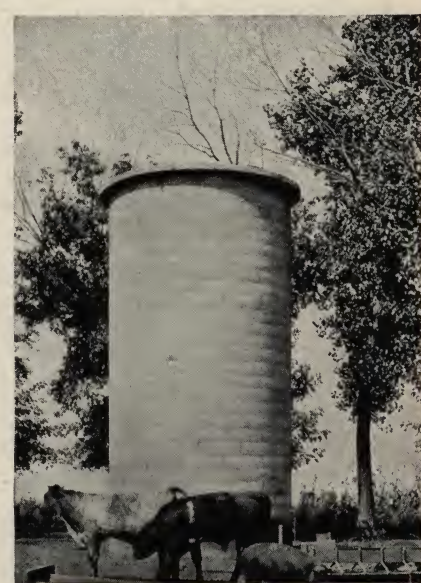
A suggested plan for a farm implement shed is given here. This building is 20 feet wide and 50 feet long. The lengths, however, may be varied to suit housing capacity required. The roof is supported by a simple truss, in order that no posts or columns will interfere with the free handling of implements. Two large doors conveniently placed make it easy to move machinery in or out. The space under the roof may be utilized for storage of light implements and supplies by laying a board floor over the 2 by 8-inch cross beams.

**CONCRETE MIXTURES**

| | |
|---|---|
| Footings and foundation | 1 : 2½ : 4 |
| Floor | 1 : 2 : 4 |
| Sills and lintels | 1 : 2 : 3 |

# Water Supply Tank

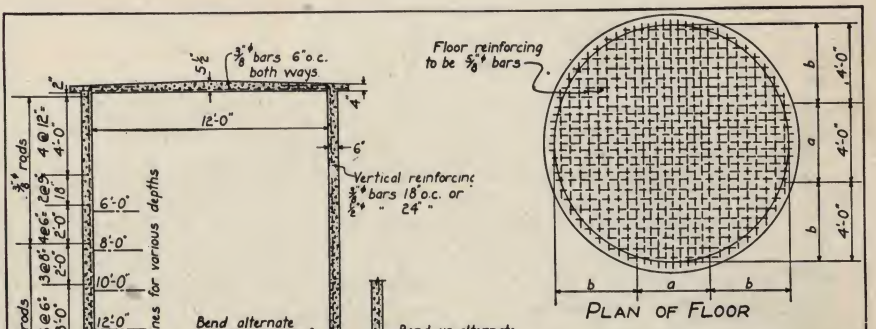
IN cutting down labor, increasing profits, and improving living conditions on the farm, a gravity water system is worth many times its cost.



A concrete tank provides storage for an adequate supply of clean, fresh water.

The water supply tank shown in the drawing on this page is 12 feet in diameter and can be built on the top of a monolithic concrete silo if desired. Because the silo is generally the tallest structure on the place, a water tank located on top of it will develop pressure sufficient to force water to every building. Much needed fire protection is thus obtained.

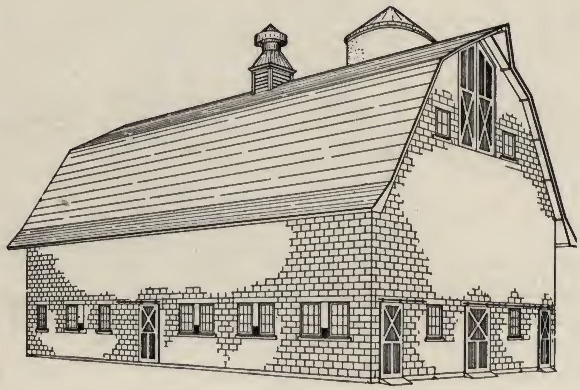
The drawing indicates the proper amount of reinforcement for tanks of different depths to 16 feet and the table gives the proper thickness of floor slab and correct amount of reinforcement for tanks of different depths. A 1:2:3 concrete mixture should be used throughout.



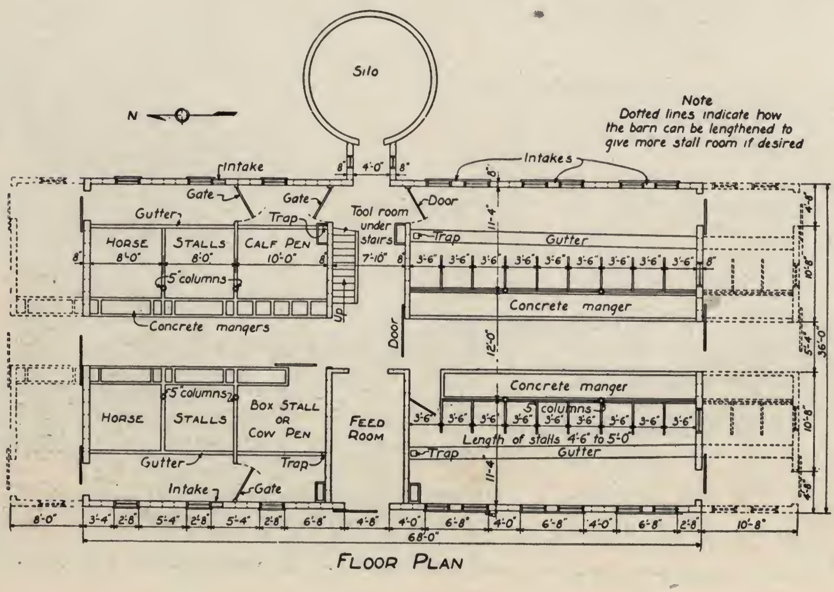

| Depth of tank | Thickness of floor | Size of bars | Spacing in "a" | Spacing in "b" | Capacity in Gal |
|---|---|---|---|---|---|
| 6'-0" | 7" | 5/8" | 7½" | 10" | 5075 |
| 8'-0" | 7½" | " | 6½" | 9" | 6770 |
| 10'-0" | 8½" | " | 6" | 9" | 8460 |
| 12'-0" | 9" | " | 5½" | 8" | 10150 |
| 14'-0" | 9½" | " | 5" | 7" | 11845 |
| 16'-0" | 10" | " | 4½" | 6" | 13540 |

# General Purpose Barn

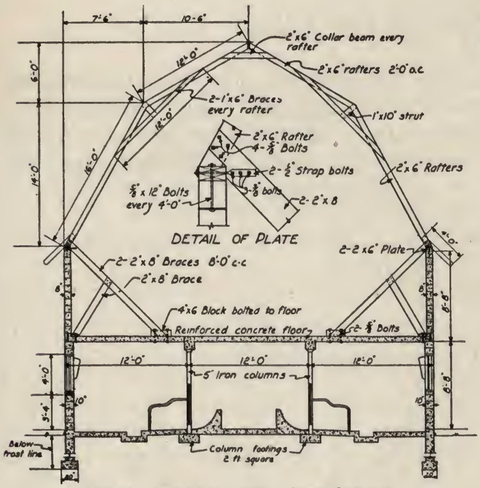
A FEATURE of the general purpose barn plan shown below is that it can be altered to give any capacity desired. The dotted lines indicate how either end of the barn can be extended to provide additional stalls for horses or cows; likewise the barn can be shortened if less capacity is required. It can be converted into a structure for housing dairy cattle only, or it can be made to cover the requirements of a horse barn with only minor structural changes. The silo and the feed bins are located near the center to permit future extension of the barn on either end. This location saves steps at feeding time. The type of roof framing shown on the opposite page gives the maximum amount of clear loft space and yet is economical and rigid.



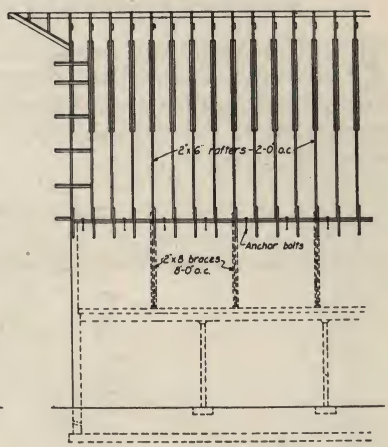
If possible the barn should be located so that its long dimension will extend north and south, thus presenting the greatest area of window opening on the east and west sides.




FLOOR PLAN




CROSS SECTION THRU COW STALLS




SIDE FRAMING

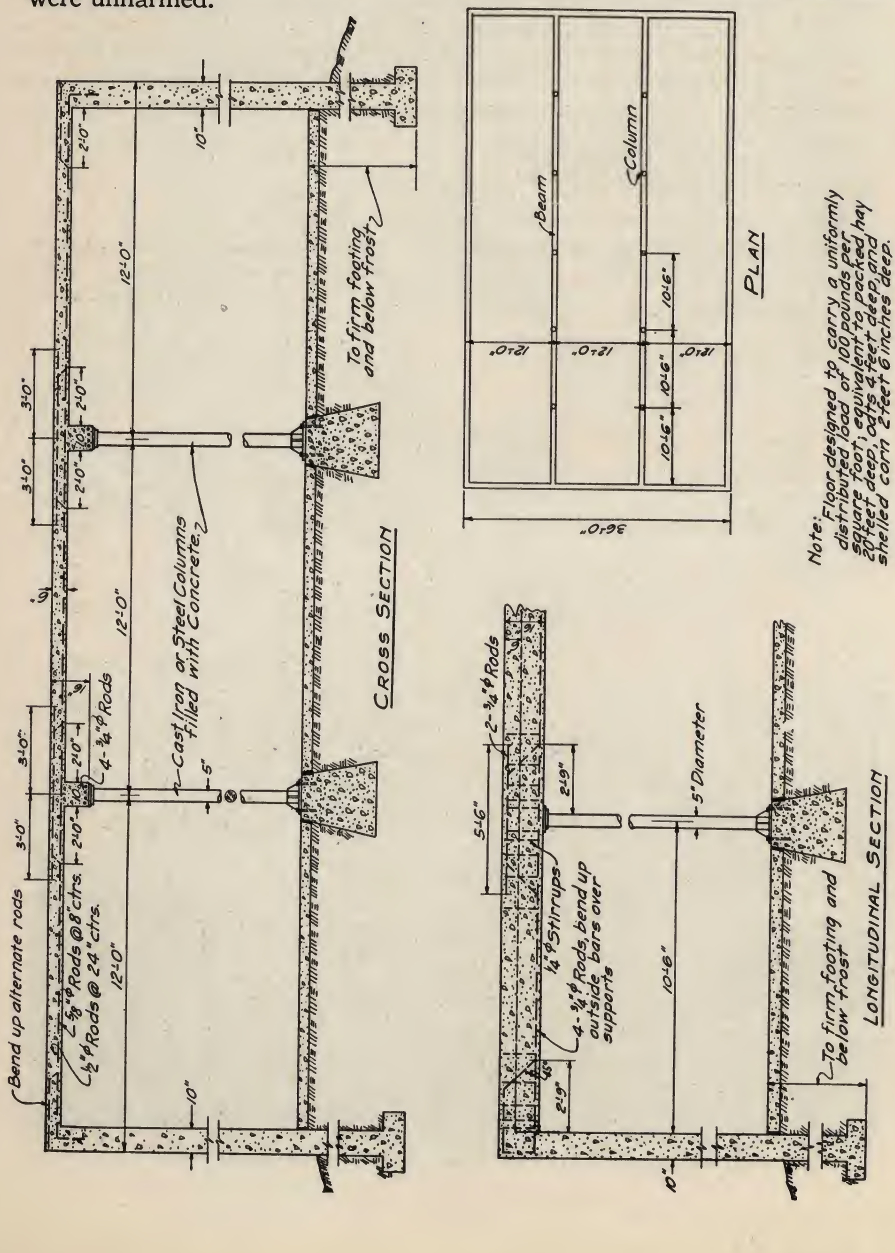
## CONCRETE MIXTURES

| | |
|---|---|
| Footings and foundation | 1 : 2½ : 4 |
| Floor, manger, alleyways, etc. | 1 : 2 : 4 |
| Loft floor (reinforced concrete) | 1 : 2 : 4 |
| Side walls (concrete masonry units). | |

A well-built and well-arranged barn lowers the cost of feeding and otherwise caring for the stock.

# Reinforced Concrete Loft Floor

FOR complete fire protection, the loft floor should be of reinforced concrete construction. The merits of this type of construction have been proved by fires where the entire contents of lofts have been destroyed by fire, while the animals below were led to safety and stock quarters were unharmed.



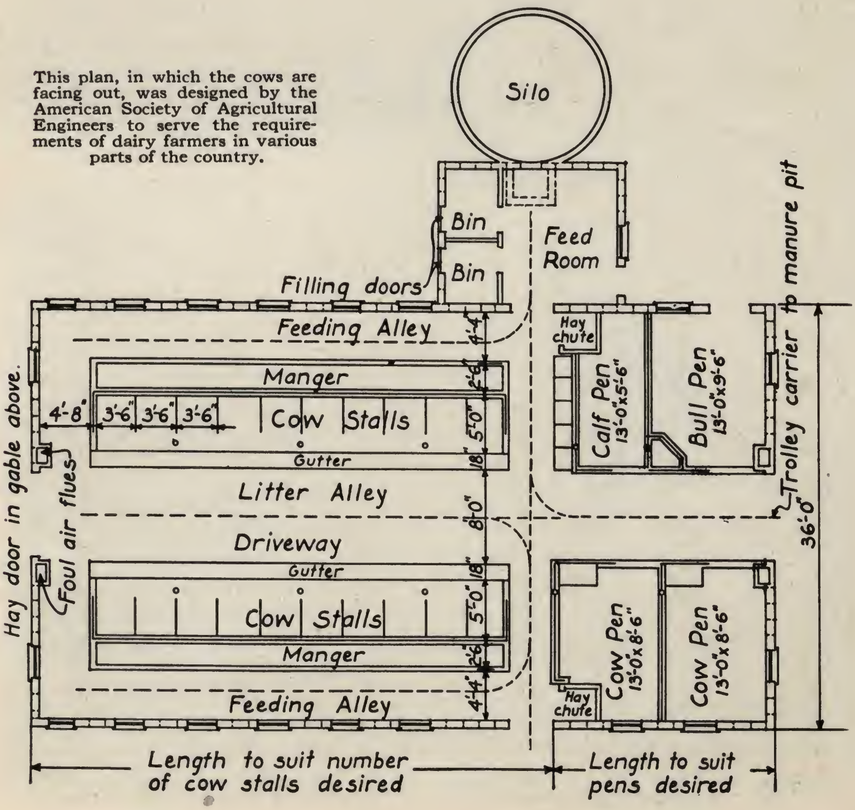
# Dairy Barns

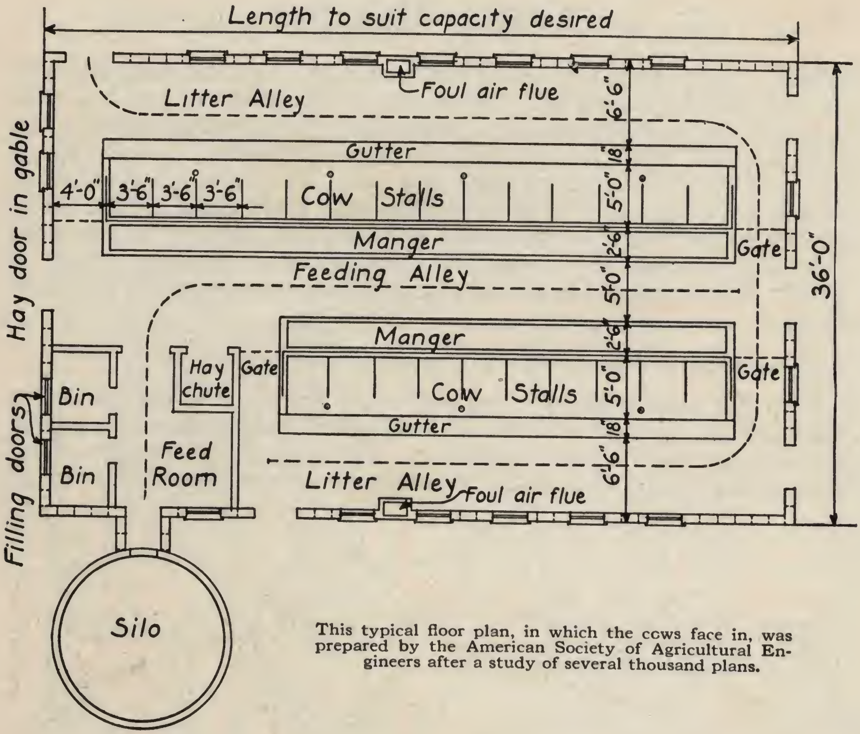
THE dairy barn plans shown below and on the following page were designed by the Farm Structures Committee of the American Society of Agricultural Engineers after a study embracing several thousand suggested arrangements. In one of the plans the cows are placed facing in, while in the other they face out. The cows are faced in or out largely according to personal preference. Both plans will be found satisfactory for a one-story, a one and one-half story or a two-story barn. In the case of a two-story barn, the barn framing shown on page 37 may be used. Roof framing for a one-story barn is shown on page 43.

### Construction of Floors and Mangers

After the barn walls have been built, all boards, rubbish, and other material within the enclosure should be removed and the floor area graded to the required level, allowing for the thickness of the concrete floor. The soil where the concrete is to be laid should be compacted thoroughly.

This plan, in which the cows are facing out, was designed by the American Society of Agricultural Engineers to serve the requirements of dairy farmers in various parts of the country.



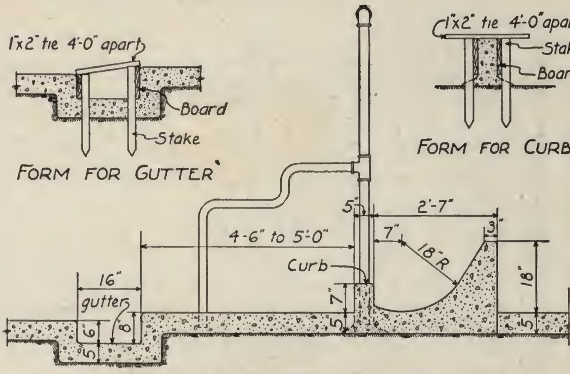



This typical floor plan, in which the cows face in, was prepared by the American Society of Agricultural Engineers after a study of several thousand plans.

An abundance of sunlight, uniform temperature, a plentiful supply of fresh air, and the highest possible degree of cleanliness, make this one-story, concrete barn ideal for housing dairy cattle.

The concrete may be placed directly on the earth if the building is located on high ground or where drainage from beneath the floor is good. Otherwise, a 6 or 8-inch fill of cinders or gravel is advisable.

Barn floors are usually made to average 6 inches thick, the full thickness being placed in one operation, using the same mixture of concrete throughout. This is known as one-course construction. The manger curb is usually placed first. It should be at least 5 inches thick and about 7 inches high above the floor on the stall side. Feed and litter alleys are usually placed after the curb; then the stall platform and manger are placed.




SECTION THRU STANDARD COW STALL

The utmost degree of sanitation is made possible when the dairy barn floors and mangers are made of concrete.

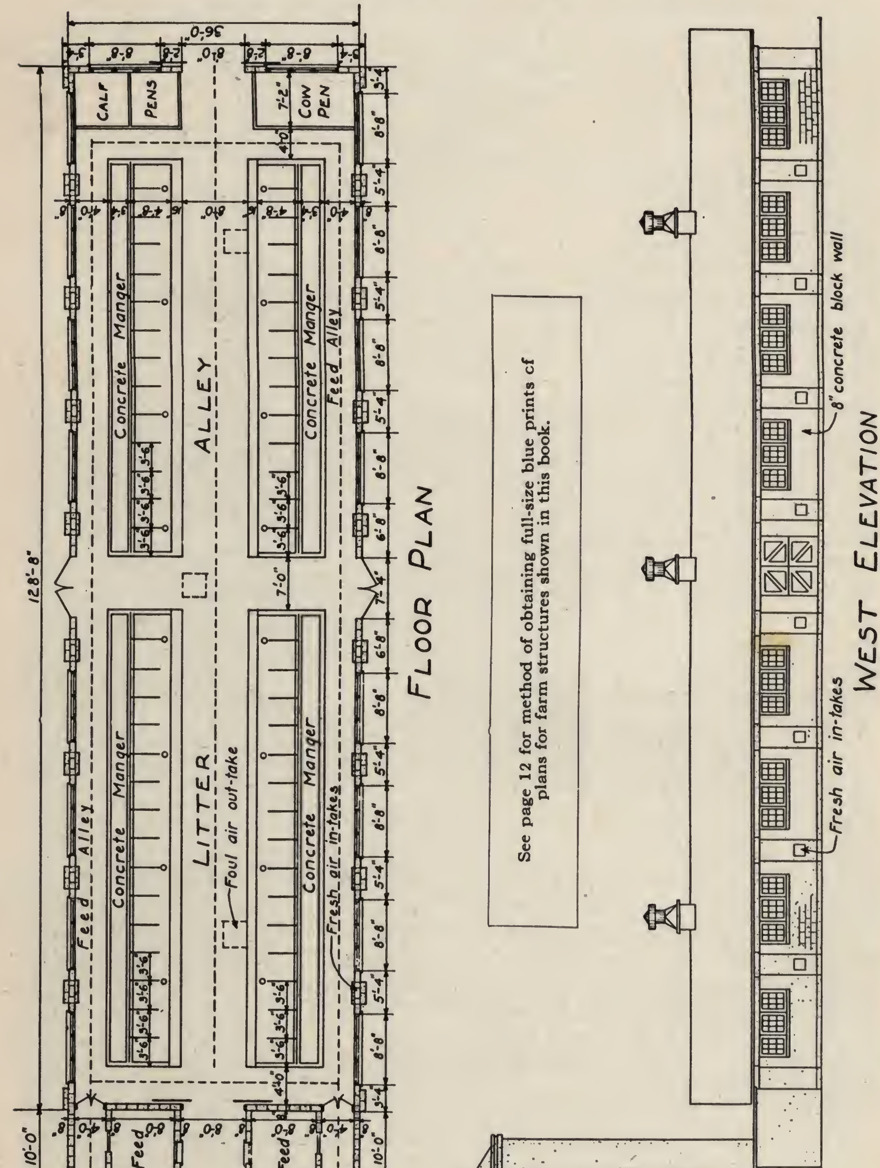
Dairy barn floors, mangers and alleys should be made of 1:2:4 concrete. Stall floors and alley floors should be finished with a wood float. Mangers should be finished smooth with a steel trowel.

The length of stall platform, that is, the distance from manger curb to gutter, will depend upon the breed of cattle kept. The width of stall should also be varied according to the size of cattle. The table below indicates the proper length and width of stalls for several breeds.

### DIMENSIONS FOR COW STALLS

| Breed | Width | Length | | |
|---|---|---|---|---|
| | | Small | Medium | Large |
| Holstein | 3'-6" to 4'-0" | 4'-10" | 5'- 2" | 5'-8" |
| Shorthorn | 3'-6" to 4'-0" | 4'- 8" | 5'- 0" | 5'-6" |
| Ayrshire | 3'-6" to 3'-8" | 4'- 6" | 5'- 0" | 5'-6" |
| Guernsey | 3'-4" to 3'-6" | 4'- 6" | 4'-10" | 5'-4" |
| Jersey | 3'-4" to 3'-6" | 4'- 4" | 4'- 8" | 5'-0" |
| Heifer (of any breed) | 2'-9" to 3'-2" | 3'- 8" | 3'-10" | 4'-2" |

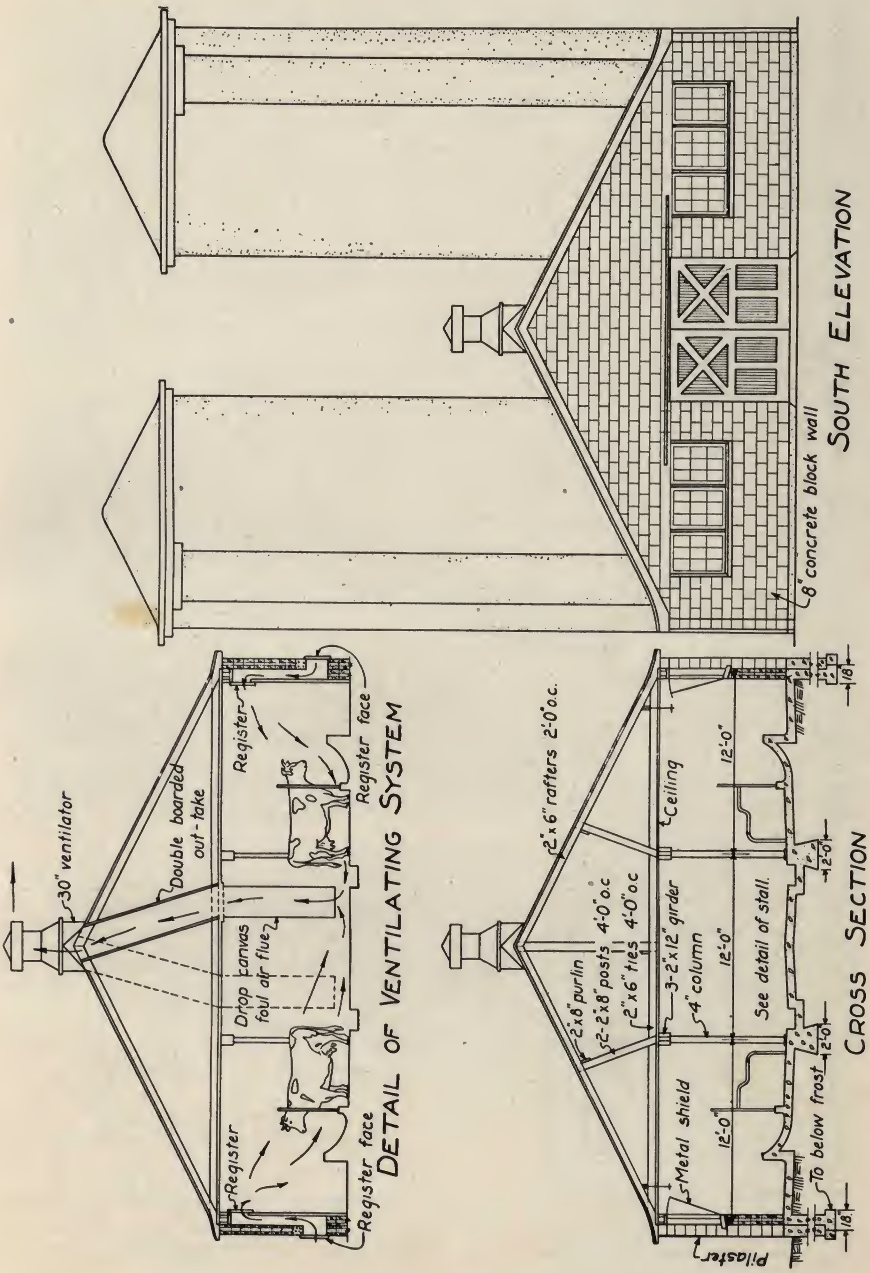
# One-Story Dairy Barn




See page 12 for method of obtaining full-size blue prints cf plans for farm structures shown in this book.

Plan and side elevation for one-story dairy barn. End elevation and cross-sections are shown on page 43.

# One-Story Dairy Barn



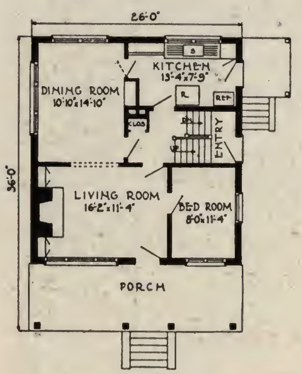

Cross-sections and elevation for one-story dairy barn. Floor plan is shown on page 42.

# Farm Residences

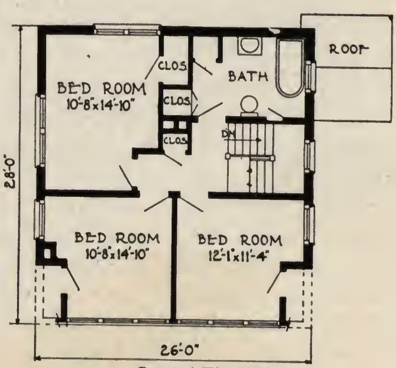
THE durable qualities of a concrete masonry house appeal to thrifty farm owners. With such a house, maintenance and repair expenses are practically eliminated. The staunch character of concrete masonry construction makes these houses unusually storm-safe. This is a very important consideration in many sections. The fire-resistive properties of concrete further safeguard the house as well as its occupants.

The three houses illustrated appear in our book, "Plans for Concrete Houses" which contains designs for 37 other attractive homes. Blue prints of any of these houses may be obtained as explained on page 12. The plans include bungalows, cottages and two-story residences in a variety of architectural styles. The price of this book is One Dollar.

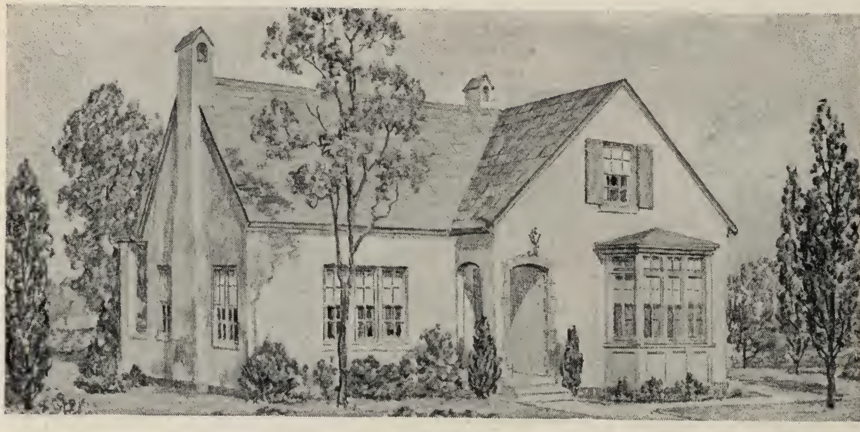
The Middlebury



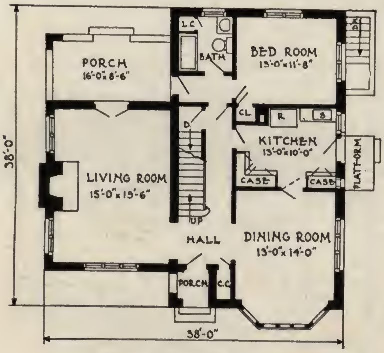

First Floor Plan



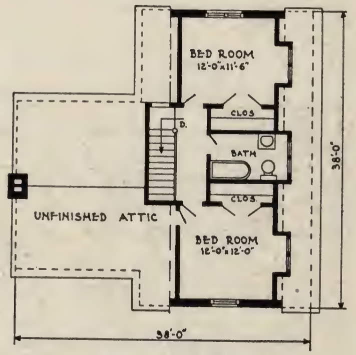

Second Floor Plan



The Pelham



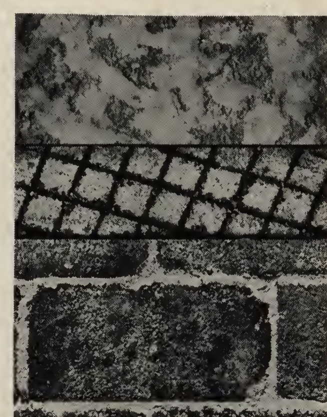

First Floor Plan




Second Floor Plan

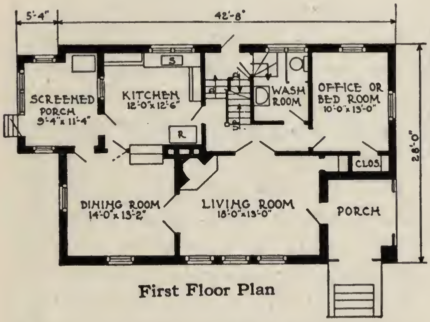
## Portland Cement Stucco

Portland cement stucco makes a very attractive as well as a very durable finish for residences. A great variety of interesting surfaces of different textures and colors are now possible with Portland cement stucco. Applied on a wall of concrete block or concrete building tile as a backing, cement stucco clings tenaciously. Cracking or spalling is entirely eliminated; the stucco is on to stay. Our booklet "Stucco Surfacing with Portland Cement" shows a number of panels of different finishes and describes how they are produced. A copy of this booklet will be mailed on request. Address our Kansas City office.

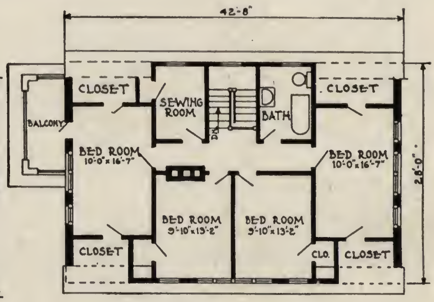


Portland cement stucco applied to concrete masonry wall—construction that is both permanent and attractive.

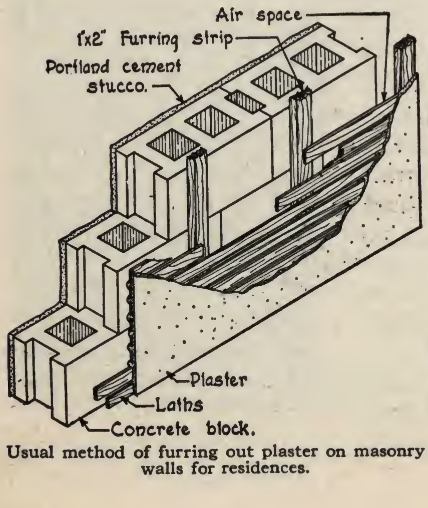
The Wakefield




First Floor Plan




Second Floor Plan



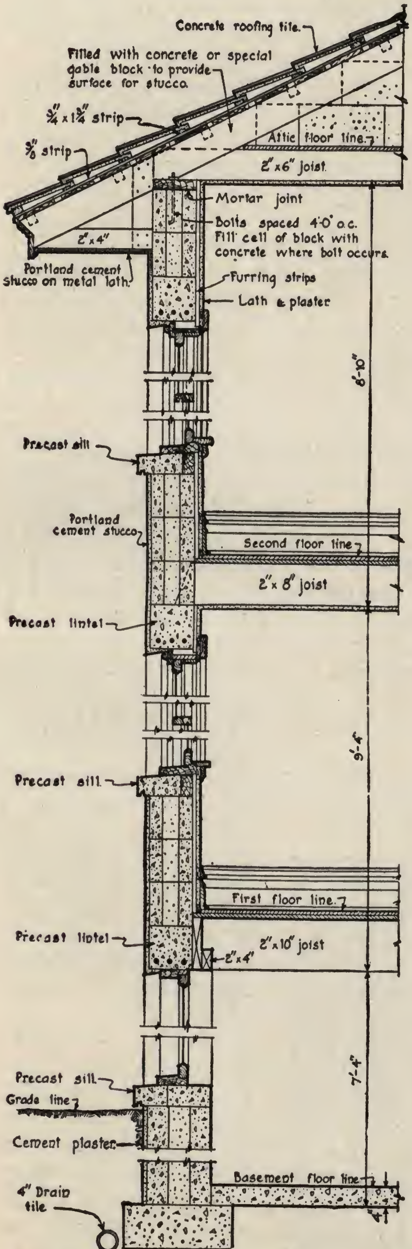

Usual method of furring out plaster on masonry walls for residences.

## Furring and Lathing

In masonry houses it is common practice to fur out the plaster so as to provide an air space between the plaster and the wall.

The air space thus formed usually affords sufficient insulation so that plaster is about the same temperature as the air within the rooms, preventing condensation and assuring a dry wall. The insulating air space makes the house easy to keep at even temperatures. In summer this means cooler rooms, and in winter a saving in fuel bills. Fuel saved soon repays for the cost of furring out the plaster.

# House Construction Details




Wall section of a concrete masonry house.

## Wall Footings

Properly built footings prevent settlement and cracking of plaster and walls and prolong the life of the building. Footings should always rest on firm soil and extend to below possible frost penetration. Under average conditions a footing 18 inches wide will be satisfactory for residences up to two stories in height. Such a footing is usually made eight or nine inches thick, using a 1:2½:4 mixture.

## Dry Basement Walls

Basement walls should be built to exclude moisture. Both monolithic concrete and concrete masonry are extensively used for basement walls. A 1:2½:4 mixture is recommended for monolithic walls. When walls are constructed of concrete block or tile they should be carefully bedded in cement mortar. Where there is a possibility of much ground water being present, it is a good scheme to plaster the exterior wall below grade with a 1:2 cement mortar.

## Fire-Resistive Roof Coverings

A large percentage of dwelling house fires is caused by inflammable roof coverings. Roof fires ordinarily originating from the outside can be entirely eliminated by the use of cement asbestos shingles or concrete roofing tile. Besides affording fire protection, these roofing materials will withstand the action of weather almost indefinitely.

# II. Permanent Repairs on the Farm

"A STITCH in time saves nine," is just as true of farm structures as of the torn garment. Timely repairs often add many years to the useful life of even very old buildings, postponing costly replacements.

There are many ways in which concrete can be used profitably around the farmstead to improve and repair various structures. In every case repairs made with concrete will be better than the original construction. Replacement with concrete makes farm structures more sanitary, improves their appearance, increases their value from the standpoint of utility, reduces upkeep labor, and helps exclude rats, mice and other pests. Repairs made with concrete are permanent.

Repair work may be done at odd times when other farm work is not pressing. Such improvements as floors, mangers and similar interior work can be done during the winter. The only precautions necessary for cold weather concreting are to store the sand and pebbles where they will not freeze and to provide means to keep the new concrete from freezing for four or five days.

## Foundations and Walls

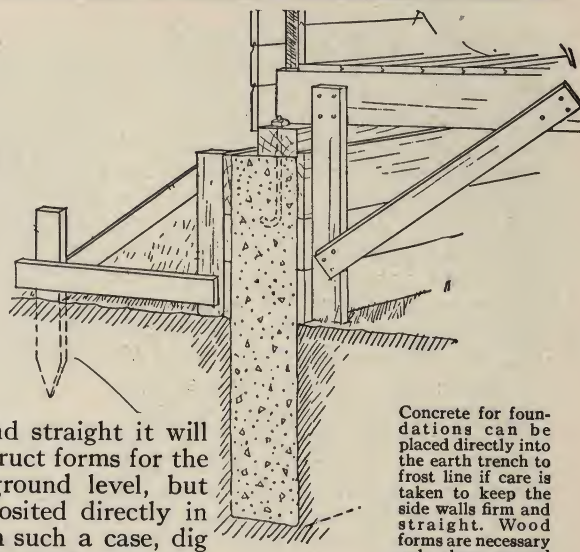
Today concrete is used almost to the exclusion of other materials for foundation walls and footings. It is very generally used for putting new foundations under old buildings. The usual method of building such a foundation is illustrated in the accompanying drawing.

After the building is raised, the trench for the foundation below grade is excavated, care being taken to make it the correct width and depth. In climates subject to freezing temperatures, foundation walls should be extended below frost penetration in order to avoid possible upheaval, and carried down to firm earth to prevent settlement of the building. This is quite important in connection with buildings having plastered interior walls.

For most farm buildings foundation walls are usually made 8 or 10 inches thick, using either monolithic concrete or concrete block. Monolithic concrete, meaning concrete placed between forms, is convenient for making foundations under buildings without basements, but when there is a basement concrete block construction is sometimes preferred because no form work is required. A monolithic concrete footing is required as a base for concrete block walls. Under

**Forms in place for a new monolithic concrete foundation.**

houses and farm buildings of moderate size, this footing is generally made about 8 inches thick and 16 to 18 inches wide. Under large, heavy farm buildings, a footing 2 feet wide and 10 or 12 inches thick may be required.



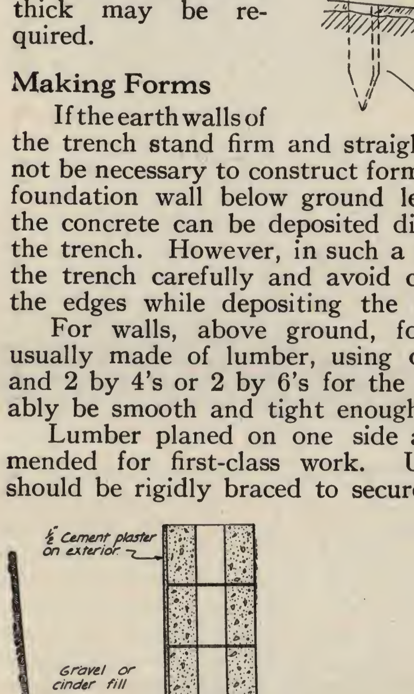
Concrete for foundations can be placed directly into the earth trench to frost line if care is taken to keep the side walls firm and straight. Wood forms are necessary only above ground level as shown.

## Making Forms

If the earth walls of the trench stand firm and straight it will not be necessary to construct forms for the foundation wall below ground level, but the concrete can be deposited directly in the trench. However, in such a case, dig the trench carefully and avoid caving in the edges while depositing the concrete.

For walls, above ground, forms are usually made of lumber, using one-inch material for the form faces and 2 by 4's or 2 by 6's for the studs. Form boards should preferably be smooth and tight enough to prevent leakage at joints.

Lumber planed on one side and having matched joints is recommended for first-class work. Under all circumstances, the forms should be rigidly braced to secure a straight wall of neat appearance. Pieces of wood about 1 by 2 inches in cross-section and cut to a length equal to the wall thickness are placed between inner and outer forms at 3 or 4-foot intervals to keep them the exact distance apart. These are removed as concrete is deposited. To prevent bulging of forms, the inner and outer sections may be wired together, the wires extending through the form boards and around the form studs. Upon removal of the forms, the wires are clipped flush with the wall surface.



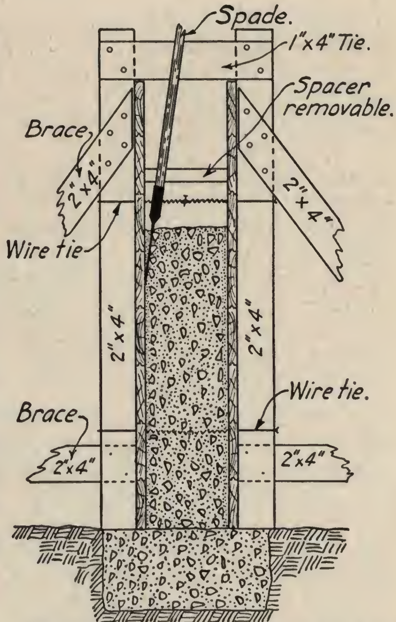

When concrete block are used for foundations a footing of monolithic concrete should be provided. In wet soils a line of tile properly laid outside the footing will insure a dry basement.

## Mixing and Placing Concrete

For foundation walls and footings, concrete mixed in the proportion of 1 part portland cement to 2½ parts sand and 4 parts pebbles or crushed rock is satisfactory. The concrete after being

thoroughly mixed is deposited in the trench or in the forms in layers from six to twelve inches deep. As concrete is deposited, it is tamped or spaded, using a spade or a thin board, sharpened like a chisel on one end, for the purpose. This operation pushes large pebbles away from the surface and releases any air that may have been entrapped when concrete was placed. Careful spading produces a denser concrete and a smooth, neat surface when forms are taken off.

Forms may be removed as soon as concrete has hardened sufficiently to be self-sustaining. In warm weather, one or two days is usually enough. If holes are found on the surface upon removal of forms, these can be filled with cement mortar, using about the same mixture as was used in the wall itself so that patched spots will match the wall.



"Spading" of concrete in wall forms forces the coarse aggregate back from the face and produces a smooth surface on the finished wall.

## Concrete Masonry Construction

Concrete block construction is often more convenient than monolithic concrete for the construction of the foundation wall above grade and for walls enclosing basements. The most common dimensions for concrete block are 8 by 8 by 16 inches, producing a wall eight inches thick and courses eight inches high. Mortar for laying the block is mixed in the proportion of 1 part portland cement, 1 part hydrated or well slaked lime, and 6 parts clean sand. Both vertical and horizontal joints should average around ¼ inch thick. More complete information on foundation wall and basement construction is presented in our booklet "Foundation Walls and Basements of Concrete" which is furnished free on request. Send your request to our nearest district office, shown in the list which appears on the back cover of this booklet.

## Floors

Concrete is the most acceptable material for reflooring farm buildings, particularly those which it is desired to make ratproof or in which a high degree of cleanliness is to be maintained, such as dairy barns and milkhouses. The ease with which concrete floors can be cleaned and kept clean makes it the preferred material for floors in poultry houses, hog houses and other buildings in which livestock is housed.

A concrete floor is probably the easiest of all concrete farm improvements to make. First remove all boards, sticks, rubbish and other material from the area to be paved, then fill in any soft or low

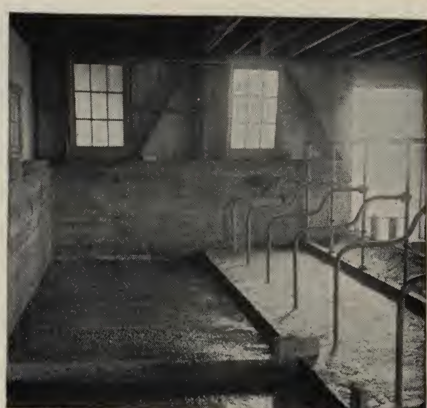
For convenience in finishing, concrete floors are usually laid in alternate strips.

spots and tamp them until firm. The concrete may be placed directly on the earth if the building is located on high ground or where drainage from beneath the floor is good. Otherwise, a 6 or 8-inch fill of cinders or gravel is advisable.

Floors of concrete are usually built in sections or in strips for convenience in placing concrete and finishing the surface. In dairy barns and horse barns, floors are made from 5 to 6 inches thick. In hog houses, a thickness of 4 or 5 inches is satisfactory, while in poultry houses 3 inches is often sufficient.

Basement floors in residences should not be less than 4 inches thick. One-course work is recommended for all types of floors, which means that the full thickness of the floor is placed in one operation, using the same mixture of concrete throughout. A small amount of cement mortar (1 part cement and 3 parts sand) may be used in finishing if necessary. Usually no trouble will be experienced in obtaining a satisfactory surface with the standard floor mixture of 1 part cement, 2 parts sand, and 3 parts pebbles or crushed stone if it be tamped well to force the larger particles away from the surface. Finishing is done with a wood float in order to obtain a smooth yet gritty surface. Concrete should be kept moist until the surface is sufficiently hard to carry traffic.

Careful attention to details is essential in dairy barn floor construction. Forms for defining floor slabs, alleyways or other areas to be concreted should be of smooth lumber and carefully set to proper grade. The manger curb is usually placed first. It should be not less than 5 inches thick and is usually made about 6 inches high on the stall side. The uprights or brackets for attachment of steel stanchions are embedded in the concrete. Feed and litter alleys are usually placed after the curb, then the stall platform and manger. The length of stall platform, that is, the distance from manger curb to gutter, will depend upon the breed of cattle kept. For Jerseys and Guernseys, the minimum length is about 4 feet 6 inches; for Holsteins, 5 feet is necessary. The platform should be pitched about one inch from curb toward gutter.

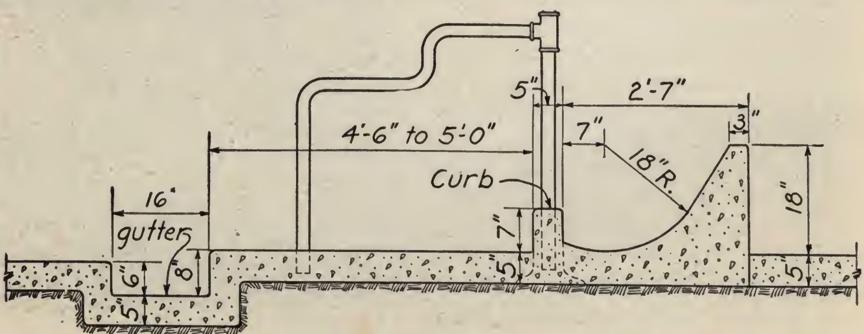


A new concrete floor in the old dairy barn is an approved sanitary measure that lessens labor and saves money.

With a special pattern or template it is easy to obtain uniform curvature of the concrete for the new manger.

## Feed Mangers

CONCRETE mangers in dairy barns are usually built at the same time as the floors, using the same mixture of concrete (1 part cement, 2 parts sand, 3 parts pebbles or crushed rock). Forms for building mangers are illustrated by the photograph on this page. The proper curvature in the manger is obtained by the use of a special pattern or template. Most manufacturers of dairy barn equipment furnish manger templates to assist the builder in constructing a manger that will be suitable for their manger partitions. Since a smooth surface is desirable for the cattle to eat from, a steel trowel is used in finishing. However, use the trowel sparingly as excess troweling may cause hair checks to form on the surface when the concrete hardens. When steel stanchions and other modern dairy barn equipment are installed in connection with concrete floors and mangers, it is a good plan to follow the directions of the company furnishing the equipment as it is difficult to make changes in concrete after it hardens.

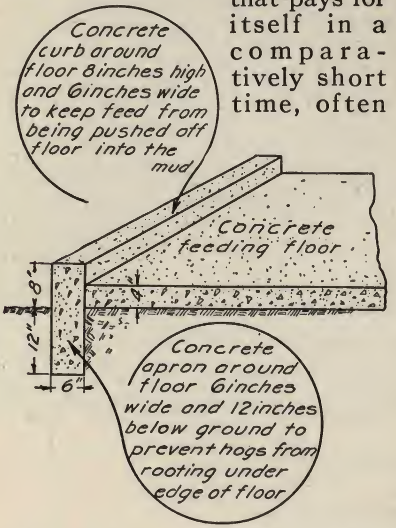



This section through a dairy barn floor shows the dimensions for standard manger, stall and gutter construction.

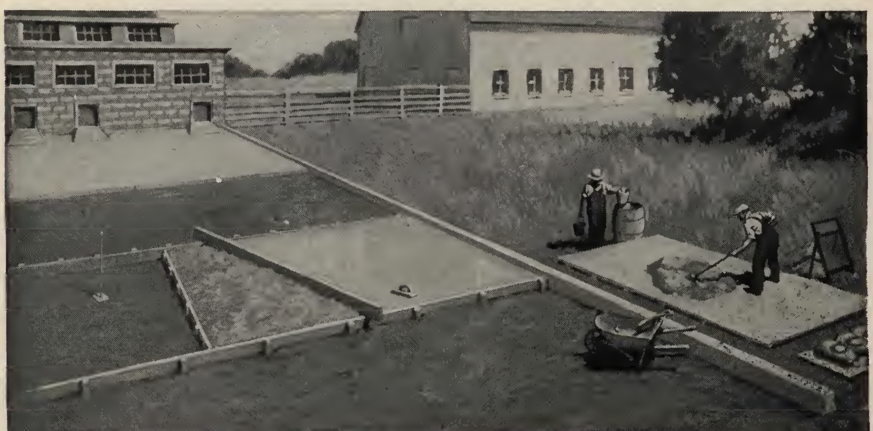
## Feeding Floors and Barnyard Pavements

A concrete feeding floor is a profitable substitute for the unpaved feed lot.

A CONCRETE feeding floor for the hogs or a pavement in the barnyard is an improvement that pays for itself in a comparatively short time, often




in less than a year. Feeding floors are usually made four inches, whereas a pavement should be six inches thick in order to withstand heavy loads. Either a 1 : 2 : 3 mixture of cement, sand and pebbles, or a 1 : 2 : 4 mixture is recommended. Concreting is done by dividing the area to be paved in sections from six to ten feet square, or in strips of convenient width. Forms consist of 2 by 4's or 2 by 6's set on edge and firmly staked to proper grade so that they can be used as a guide in obtaining the proper slope for the pavement. A wood float is employed in finishing. Just as soon as the concrete has hardened sufficiently that its surface will not become marred, cover it with several inches of moist earth, sand or straw to prevent evaporation of moisture. Sprinkle the covering often to keep it damp for ten days or two weeks. At the end of this time the covering may be removed and the floor put into service.

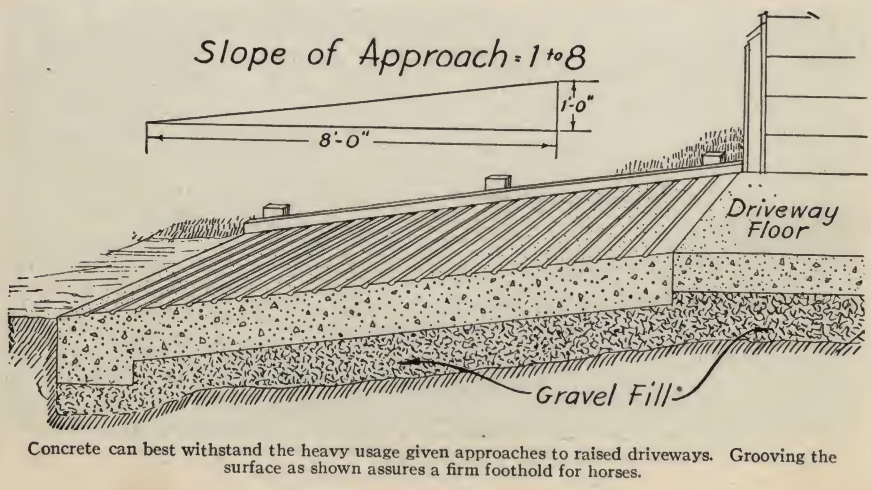


Construction of feeding floors and pavements is simplified by dividing the space into squares or strips and placing the concrete by sections.

The surface of concrete floors and pavements should be finished with a wood float to give the even gritty texture that prevents slipping.

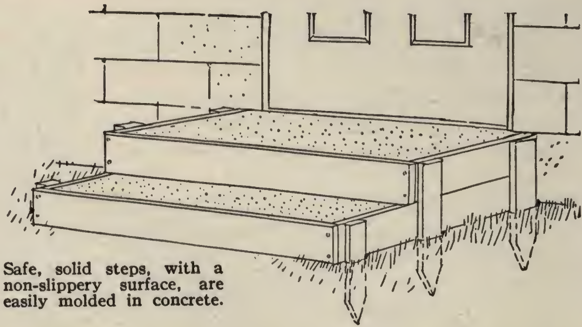
## Concrete Approach

THERE is no better material for driveways to granaries, barns, and other buildings than concrete. It possesses the necessary strength to withstand the hard usage common to such structures. For ordinary loads make the slab at least 6 inches thick; if heavy loads are to be carried the thickness should be 8 inches. A 1:2:3 mixture is recommended. Grooves can be cut in the surface with a trowel or can be made by pressing triangular strips into the fresh concrete.




Concrete can best withstand the heavy usage given approaches to raised driveways. Grooving the surface as shown assures a firm foothold for horses.

## Concrete Steps



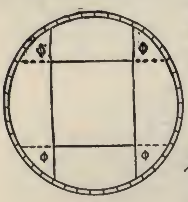
Safe, solid steps, with a non-slippery surface, are easily molded in concrete.

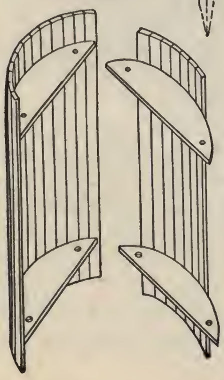
CONCRETE steps are safe, non-slippery in wet weather, and they last indefinitely. Simple forms for building steps are shown in a drawing on this page. Either one-inch or two-inch lumber may be used for forms, whichever is available. A 1 : 2 : 3 concrete mixture is standard for this purpose. Finish with a wood float so as to produce a smooth yet gritty surface.

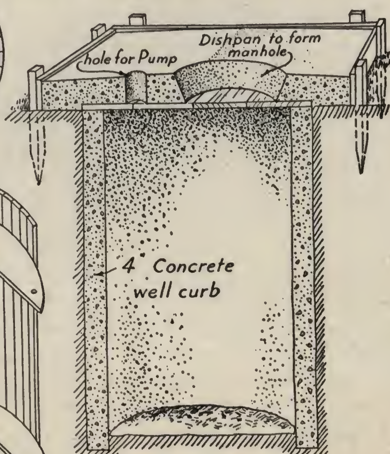
## Well Curb and Platform

Adequate protection of the drinking water supply demands that surface pollution of wells be prevented. This is most readily accomplished with a concrete curb and a concrete well platform. In shallow wells, the concrete curb is often extended from top to bottom. In deeper wells and in repairing old wells, a curb extended down seven or eight feet will ordinarily give the required protection against surface pollution.

An easily constructed form for making a circular well curb is shown in the accompanying sketch. No outer form is needed if the earthen sides of the well are firm enough to stand without caving. Forms should be made of such size that when assembled and set in the well there will remain a clear space of four inches all around for filling with a 1 : 2 : 3 mixture of concrete. The forms shown are designed to make their removal easy and so that they can be raised and reset to build as many sections as required.








Take no chances with your water supply—protect your well with a concrete curb and cover.

The usual forms for making well platforms are also shown. A manhole is provided by setting an ordinary dishpan, 18 or 20 inches across, on the form at the proper place. A cover to fit this opening is made by casting it in the dishpan. A hole for the pump is made by placing concrete around a strip of tin bent in the form of a

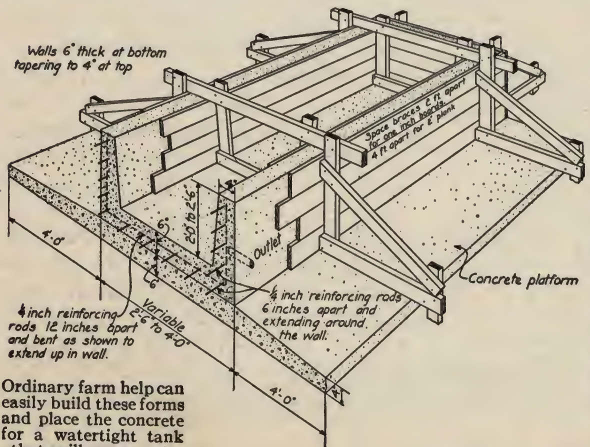
cylinder which can be collapsed and removed after the concrete has hardened. For the well platform, which should be 6 inches thick, use a 1:2:3 concrete mixture. Some reinforcement, either ¼-inch rods or wire mesh, is desirable, the reinforcing materials being located about one inch from the underside of the slab in both directions, continuing them around the manhole by bending. Space the rods about six inches apart in both directions.

Wells encased in concrete protect the farm water supply and help preserve the health of the family.

## Watering Tanks

Concrete, because it is clean, sanitary and permanent, is the best material to use in replacing tanks that have rotted or have become unusable. Concrete tanks do not rot, rust, warp or wear out.

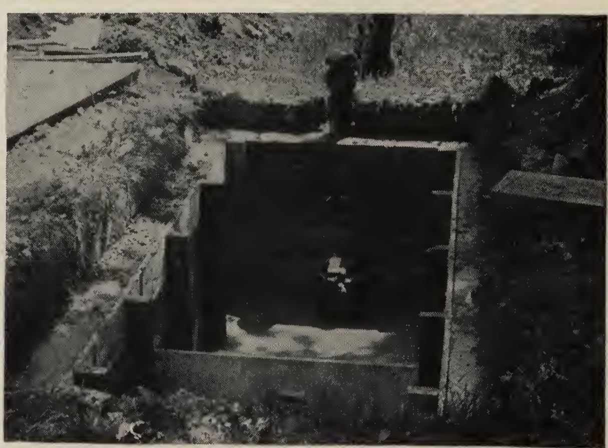
A 1 : 2 : 3 mixture is recommended for all structures designed to hold water. The method of constructing forms is shown in the drawing below. After the outside form is placed, concrete three inches deep is deposited evenly over floor. Then the reinforcement consisting of ¼ or ⅜-inch rods, bent and wired together at intersections to form a sort of cage or basket, is placed. If rods are not readily obtainable woven wire fencing may be used, care being taken to extend it entirely around the structure and across the floor and up to the side and end walls. After the reinforcement is placed, concrete is deposited to complete the full thickness of the tank floor. It is then time to set the inside forms which should be built before concreting is started. Concrete is then deposited in six-inch layers in side walls until forms are filled, carefully spading it and tamping it thoroughly. After the concrete has hardened sufficiently to be self-sustaining, the forms may be removed. It is advisable at this time to give the interior a cement wash to insure smooth interior surface and watertightness. The concrete should be protected for a week or ten days, after which time the tank may be put in use.




Ordinary farm help can easily build these forms and place the concrete for a watertight tank that will never rot.

# CONCRETE SEPTIC TANKS

The septic tank method is the most satisfactory for disposal of household and human wastes where a municipal sewerage system is not accessible. It is not new, for it has been thoroughly tried in this country during the last 40 years under the supervision of competent engineers and health authorities, and has proved effective in practically complete disposal of sewage. With a properly constructed septic tank and absorption system the disposal of the sewage can be directed and controlled so that all the undesirable and unsanitary features of the cesspool are eliminated.



A concrete septic tank is the safest and surest device for disposing of the sewage from isolated households.

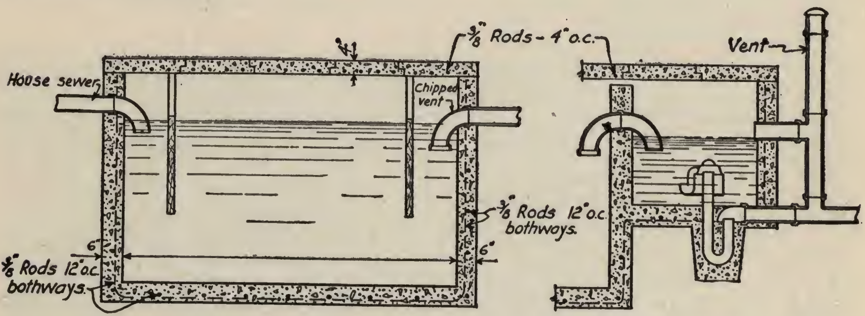
Concrete, because of its permanence, adaptability and solidity is peculiarly suited to septic tank construction. The materials are obtainable practically everywhere and can easily be converted into the simple structure constituting the septic tank. With concrete it can also be made water-tight, which is essential.

## How a Septic Tank Operates

The principle on which the septic tank operates is that of rotting, or bacterial decomposition. Household waste consisting mostly of liquids, but containing a certain amount of solids, is carried from the house sewer into the tank and there the solid portions are broken up and converted into liquids and gases. When the process of decomposition is well begun a scum which excludes air forms on the surface of the liquid within the tank. The process then proceeds in the absence of oxygen, anaerobic bacteria constituting the disintegrating agency. The sewage should be retained in the tank for a time which experience indicates should be not less than 24 hours in order to effect reasonably complete dissolution; then it flows out from the tank and enters upon the second stage of its disposal. Aerobic bacteria, which require air for their successful operation, are necessary for the completion of this second step and for this reason the effluent from the main tank is usually discharged into a distributing system which insures a free supply of oxygen.

Sewage should be discharged into the tank with as little disturbance

as possible of the contents and of the scum on the surface. A certain amount of insoluble material will, of course, enter the tank and this will settle to the bottom together with other partially disintegrated material, forming a sludge which may accumulate to such an extent as to make its removal necessary.




CROSS SECTION OF SINGLE CHAMBER SEPTIC TANK — CROSS SECTION OF SIPHON AND SIPHON CHAMBER.

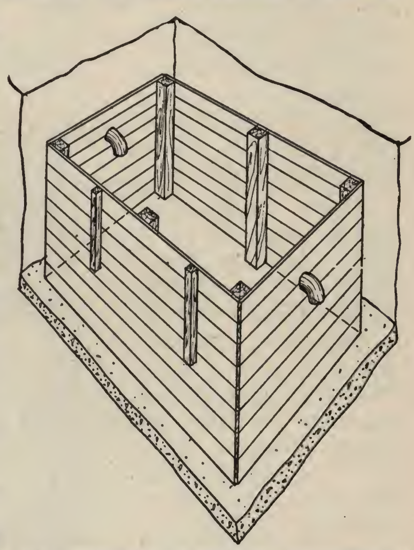
**The single chamber tank may be adapted to the use of a siphon for intermittent sewage discharge by slight modifications and adding a special siphon chamber.**

Contrary to common belief, sewage is not purified to any great extent in the septic tank itself. The work of the anaerobic bacteria is primarily chemically disruptive, in the breaking up of organic compounds. The effluent from the tank may be apparently clear; nevertheless, it is foul and dangerous and should be led into the distributing system in such a way that no danger may accompany the transmission. Here is where the concrete septic tank has its greatest advantage over the old-time cesspool, which is usually constructed with walls laid up of loose stones and permits of the continuous seepage of the dangerous liquid sewage into the open soil surrounding it.

## How to Make a Septic Tank

The simplest form of septic tank and one which in many cases gives very successful results is that of a plain, water-tight, concrete tank set below ground. Its size will vary with the amount of sewage to be disposed of. Good practice indicates that the tank should be made so that a depth of not less than four feet of liquid may be maintained, and that any increase in capacity be made by extending the length rather than the width. In this way the sewage has a longer path to travel before being discharged from the tank and the septic action is more thorough. The wastes should enter the tank with minimum velocity; for this reason the tank end of the house sewer should have very little pitch and a baffle board be erected immediately in front of the sewer outlet further to reduce the flow momentum. Likewise the discharge of the effluent should be made with minimum disturbance to the contents of the tank.

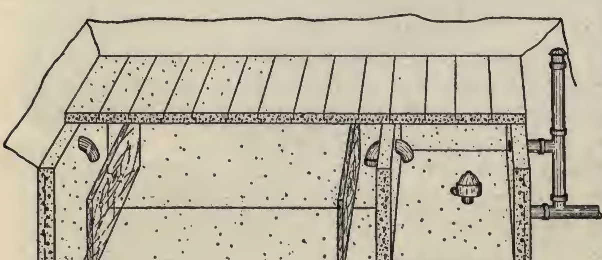
Since strength is a prime requisite, a mixture of one part of cement, two parts of sand and three parts of pebbles or broken stone should be used for the concrete. The walls and floor of the tank should be made six inches thick and reinforced with ¼-inch steel rods spaced 12 inches apart in both directions, or with heavy woven wire. The reinforcement should extend down the walls and across the bottom, forming a sort of a basket. The cover should be not less than four inches in thickness, and reinforced with ¼-inch rods. For facility in cleaning, the cover should be made in slabs that may be easily removed. In case the tank must be set at considerable depth, with the weight of several feet of soil upon its top, the cover must be made thicker and stronger than mentioned. A hollow extension to the surface of the ground large enough to admit of cleaning when necessary may be advisable.



The construction of forms for the interior of septic tanks is simple. Note the cleats which form slots for the baffle-boards.

The smallest size of tank that is practical is one for a family of five persons, which, upon the assumption that the daily sewage production is 50 gallons per person, should have a capacity of 250 gallons if the general practice of sewage retention for at least 24 hours is to be followed. In most cases septic action will begin practically as soon as sewage enters the tank, but in rare cases it may be necessary to introduce a quantity of septicized sewage from some other tank. Once started the action rarely ceases.

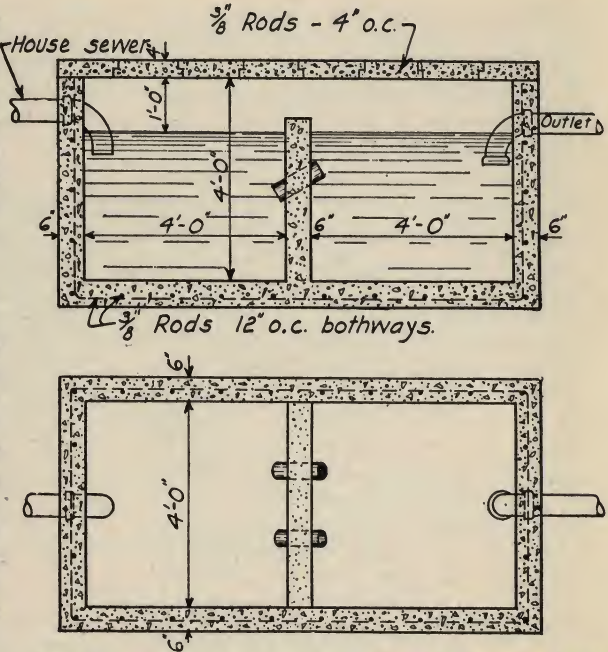
Some authorities on sewage disposal recommend the use of a tank with two or more settling chambers in preference to the single chamber type, on the basis that an additional chamber provides for a more complete decomposition of the raw sewage. Recent experiments seem to confirm this idea. The character of the sewage and the methods of handling the effluent in any particular case should also be taken into consideration, since sewage with an unusual amount of solids may require a longer time and most favorable condi-



The details of the construction of a large septic tank suitable for small schools are shown in this drawing.

tions for reasonable complete reduction. In this connection it is advisable to obtain advice from reliable local or state health authorities as to what type of installation will give the most satisfactory service.

The requirement that a tank be built with two chambers does not involve any extra difficulty in construction; it is simply an enlarged single chamber tank, with a concrete partition inserted through which is provided passage from one chamber to another. A simple type of double-chamber tank uses diagonal pipes set in the partition wall to admit the sewage from the first chamber into the second. This type of tank has been extensively and satisfactorily utilized in several localities, particularly Napa County, California, where over fifteen hundred are in use.

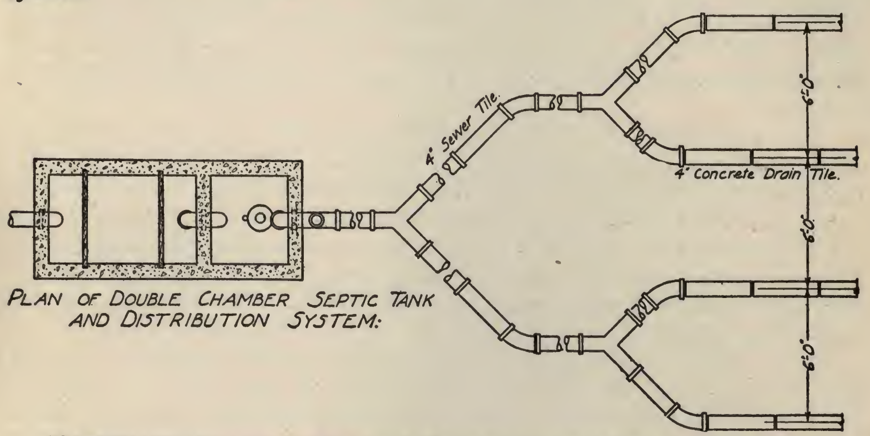


Cross section and plan views of the type of tank used in over 1,500 Napa County (Calif.) installations.


A view of a Napa County tank with cover removed.

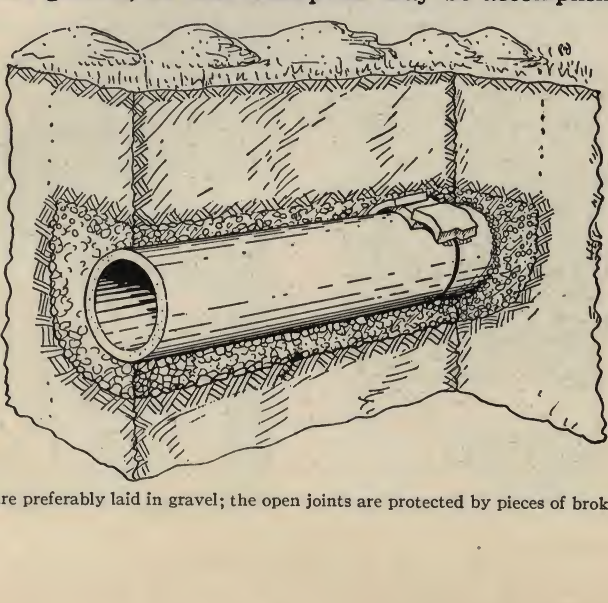
## The Distributing System

The distribution of effluent from the septic tank proper is equally as important as the septic action within the tank itself. Various methods of distribution have been devised and followed, but the most generally satisfactory and acceptable method is by means of a subsurface irrigation system.




The effluent from the septic tank is generally discharged into a subsurface absorption system.

The subsurface irrigation system consists of one or more lines of 4-inch concrete drain tile into which the effluent flows as it is discharged from the septic tank. That portion of the system which only carries the effluent to the absorption field should admit of no leakage, but in the absorption field proper the tile are laid with open joints comparatively near the surface of the ground, so that absorption may be accomplished in soil



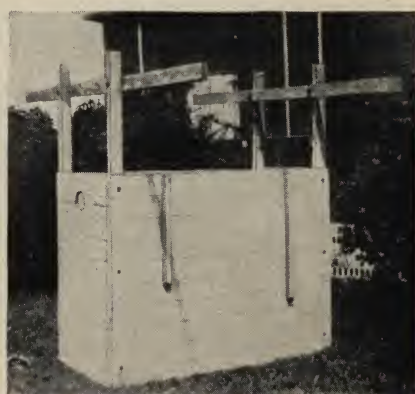
The tile are preferably laid in gravel; the open joints are protected by pieces of broken tile.

having an abundance of oxygen and affording a congenial medium in which the aerobic bacteria can effectively operate. In mild climates ten inches is sufficient depth for the distributing tile, this being increased to a maximum of eighteen inches in colder regions. The open joints are protected by pieces of broken tile to prevent dirt falling into them and clogging the tile. Uniform absorption by the soil along the entire length of the distributing tile will be facilitated by laying the tile to an accurate grade, with a fall of about two inches per 100 feet. Some authorities prefer a steeper grade at the beginning, changing gradually to a level grade at the end.

The length of the lines of tile will depend upon the amount of sewage discharged and upon the character of the soil. In sandy soils of an open texture which admits of an even absorption, good practice indicates that three feet of tile should be laid for each five gallons of daily discharge. In tight, clayey soil this should be increased to one foot or more for each gallon. In certain cases where thorough absorption is difficult, it may be necessary to surround the distributing tile with gravel, cinders, broken stone or some other similar porous material.

Other methods of distribution are sometimes followed such as surface distribution, in which case the effluent is discharged directly upon the surface of the ground; or by discharging the effluent into a stream. Both of these methods are dangerous, however, and are inadvisable except under certain very restricted conditions. Specially constructed filter beds are sometimes used, but are likely to be expensive and difficult to construct and maintain.

The type of single chamber tank, with baffles, popular in New York and Pennsylvania. Illustration at left shows top view of tank, and that below the form from which it is made. (*Courtesy Pennsylvania State College*)



# Pointers on Cold Weather Concreting

*Concrete* can be made during cold weather just as well as at any other time provided a few simple precautions are observed. In early winter when freezing occurs only at night, it is only necessary to protect the concrete from freezing after it has been placed in the forms. As the weather grows colder and freezing temperatures prevail continuously, the mixing water should be heated. In severe cold weather it is necessary to heat both water and aggregates.

## *Heating the Water*

The hotter the water used the better. Water can be heated in tanks or kettles over a fire, or by any convenient method.

## *Placing Concrete*

Frost, snow and ice, when present, must be removed from forms before concrete is placed. Concrete should be placed in forms immediately after it is mixed to prevent loss of heat acquired by warming materials.

## *Protecting Concrete*

As soon as concrete has been placed it should be protected to retain as much heat as possible. Newly placed concrete walks, floors, pavements and other flat surfaces can be protected by covering with heavy paper and then with dry hay or straw or with manure, ten to twelve inches deep. Outside walls can be protected by coverings of canvas or straw or by building enclosures around them and heating the interior with oil or coke stoves (the latter commonly known as salamanders), or some other form of stove which will provide considerable heat without smoke.

## *Removing Forms*

Too early removal of forms must be carefully guarded against. Frozen concrete is frequently mistaken for properly hardened concrete. It may have the same "ring" when struck with a hammer. A reliable test is to apply heat or hot water to the surface. If frozen, it will soften on thawing.

## *Haul Materials Early*

Sand and gravel should be hauled in the fall before the pit freezes and stored under cover near the proposed job.

## *How Concrete Hardens*

Heat hastens the hardening of concrete; cold retards it. At about 80 degrees Fahrenheit concrete hardens rapidly. Below this temperature the rate of hardening decreases. When the temperature is around 50 degrees, the process of hardening is quite slow and at the freezing point ceases entirely. Concrete kept at a temperature of 60 degrees, or higher, soon hardens sufficiently to be safe against damage by frost. The warmer it is kept the sooner it will reach the point where frost cannot harm it. The general opinion is that 48 hours is sufficient if concrete can be kept above 60 degrees, but it is better to protect the concrete from freezing for about a week.

## *Heating Materials*

Several simple methods for heating sand and pebbles are commonly used. The materials may be banked over an old culvert pipe, a section of smokestack or some other improvised heater and a fire kindled inside. A satisfactory heater can also be made by building a fire-box of concrete block or brick with a sheet iron cover on which the aggregates are piled. Sand and pebbles are heated separately to prevent them from becoming mixed. They should be turned frequently so that frost and ice are entirely thawed out before using. On large jobs it is customary to use steam for heating materials. Cement need not be heated.

We will gladly furnish you definite information on any building or improvement work you may contemplate, or more specific data on the subjects discussed in this book.

ASH GROVE LIME & PORTLAND CEMENT COMPANY
General Offices, Kansas City, Mo.
District Sales Offices, Oklahoma City, Okla.
Cement Plant, Chanute, Kans.
New Plant Now Building, Louisville, Nebr.